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Technical Training Manual

SRS Diagnosis

- Learn how to safely disarm and rearm an SRS
- Experience system repairs through diagnostic case studies
- Reduce the likelihood of expensive workshop errors
- Repair or replace? Understand what can and can't be repaired in an SRS

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Supplementary Restraint System (SRS) Diagnosis

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LOOK FOR THESE SYMBOLS THROUGHOUT THE MANUAL

ⓘ	*Note:*	*Indicates a point of interest*
⚠	*Caution:*	*Indicates the risk of minor injury, special procedure or possible damage to a component*
⚠	*WARNING:*	*Indicates the risk of serious or life threatening injury*

Introduction

Diagnosing Supplementary Restraint Systems (SRS) is not as difficult as one might first expect. This is due to a few key factors:

- ☐ Compared to many other electronically controlled systems on a vehicle, the SRS is relatively small with the majority of systems having less than ten inputs and ten outputs at the control module
- ☐ None of the components in the SRS are serviceable (with the exception of the wiring on limited vehicles)
- ☐ Scan tools play a huge role in diagnosis. Due to the risk of deployment, it is only possible to test pyrotechnic (deployable) components with a compatible scan tool. Once a fault has been isolated to a component it simply results in a part replacement

Some technicians and workshop owners express fear of accidental deployment, personal injury and the 'unknown' as reasons for not doing or chasing lucrative SRS work.
Following a few simple procedures makes SRS diagnosis safe and as low risk as any procedure on a vehicle.

This training clinic addresses all of the key aspects for carrying out safe SRS diagnosis, from disarming procedures and pyrotechnic simulators to step-by-step tutorials through diagnostic case studies.

INTRODUCTION continued...

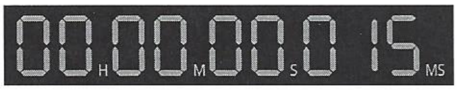
The dramatisation of vehicle accidents in movies and television programming has led to a great deal of misunderstanding about the actual events that occur during a vehicular accident involving airbag deployment.

The following analysis dissolves many of these misunderstandings by dissecting the event down to the millisecond (ms or 1/1000^{ths} of a second). The vehicle is a 2008 Ford FG Falcon XT sedan. The event is the side impact test used as part of the Australian Design Rule (ADR) compliance, which involves the test vehicle to be hit at 90° into the drivers door with a 950kg trolley travelling at 50km/h. The analysis was first published in *The Age* on September 6, 2008 as part of Ford release of the FG which was the first Australian built vehicle to achieve a five star ANCAP rating.

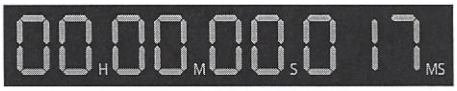
00 H 00 M 00 S 000 MS	The initial impact begins on the drivers door
00 H 00 M 00 S 001 MS	The RH side impact pressure sensor detects a pressure wave
00 H 00 M 00 S 002 MS	The RH side impact acceleration sensor in the C-pillar detects a crash event
00 H 00 M 00 S 003 MS	The safing sensor in the SRS control module detects crash vibrations
00 H 00 M 00 S 005 MS	The door intrusion structure begins to absorb energy The SRS control module analyses the signals to calculate the angle of impact and severity
00 H 00 M 00 S 006 MS	The RH side impact pressure sensor registers peak pressures
00 H 00 M 00 S 007 MS	The SRS control module has identified a significant crash event
00 H 00 M 00 S 008 MS	The SRS control module sends the deployment signal to the RH thorax airbag. The RH B-pillar begins to crumple inwards and energy begins to transfer into cross-car load path beneath the occupant
00 H 00 M 00 S 009 MS	The RH thorax igniter fires

Thorax: *The thorax is the Latin name for chest and usually used in medical and scientific literature. It refers to the area of the human body protected by the ribcage.*

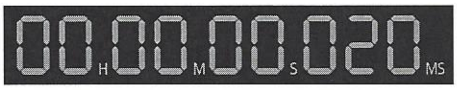
INTRODUCTION continued...



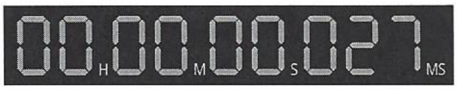
The airbag tears through the seat foam (at approx. 200km/h) as it begins to inflate
The roof begins to absorb part of the impact



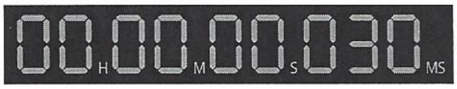
The airbag covers the drivers thorax and begins to push the shoulder away from impact zone
The cross-car load path under the rear seat reaches maximum load



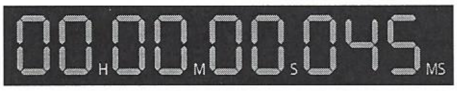
The airbag begins to push the drivers chest away from the impact. The RH front door and B-pillar begin to push on the drivers seat



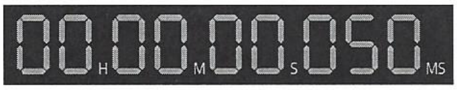
The airbag starts its controlled deflation. A "pusher block" in the seat moves the drivers pelvis away from the impact zone. The impact velocity has halved from 50 km/h to 23.5 km/h



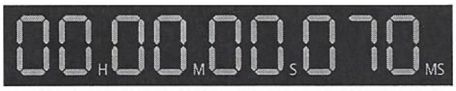
Although deflating, the airbag is still in place.
The vehicle has now absorbed all of the crash energy.
For a brief moment the driver experiences the maximum force equal to 12 times the force of gravity



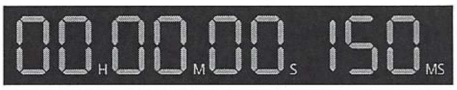
The driver and airbag move together along with deforming side structure



The SRS control module unlocks the car doors
The passenger safety cell begins to rebound, pushing the door away from driver



The airbag continues to deflate
The driver moves back towards the middle of the car
Engineers classify the crash as completed!



The driver begins to become aware of the airbag deployment

The analysis of the FG side airbag gives a rare insight into the SRS operation. Manufacturers usually keep the intricate details of deployment a closely held secret so as to attempt to maintain a competitive advantage over other brands.

INTRODUCTION continued...

SRS Components

CHAPTER TOPICS

- ☐ SRS Components (deployable)
  - Airbags
  - Seatbelt Pre-tensioners
  - Battery Isolators
- ☐ SRS Crash Sensors
  - Impact Acceleration Sensors
  - Impact Pressure Sensors

SRS COMPONENTS

The deployable devices in SRS have improved dramatically since the earliest systems were first seen on Australian market vehicles. The changes have focused mainly on the number of airbags fitted, their location and the shape of the inflated bag. The earliest systems provided protection only for the driver in frontal collisions (see 'Historical SRS' chapter) and then the front passenger received a frontal airbag. Now, both front and rear passengers may have side airbags to protect the body (thorax) and side curtain airbags to protect the head in side impact accidents and even rollovers.

Seatbelt pre-tensioners help to ensure that the occupant is located correctly in the seat for maximum benefit of the airbags.

Airbags

Front Airbag - Driver

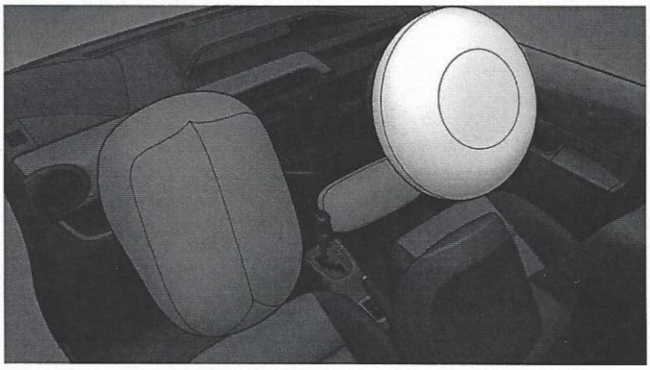


Diagram 1: Front Airbag - Driver

The front airbag for the driver is typically located in the steering wheel centre, although roof mounted drivers airbags have been developed but at this stage have not been adopted by the mainstream manufacturers. The driver airbag is connected to the SRS control module via the clockspring. Numerous OE and scantool manufacturers reference this component as DAB (Drivers AirBag).

Front Airbag - Passenger

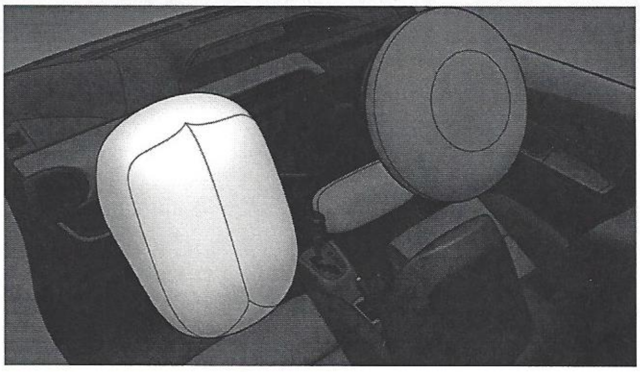


Diagram 2: Front Airbag - Passenger

The front airbag for the passenger is typically located in the left front upper area of the dashboard. As with the drivers airbag, roof mounted passenger airbags have been developed but at this stage have not been Numerous OE and scantool manufacturers reference this component as PAB (Passenger AirBag).

Knee Airbag

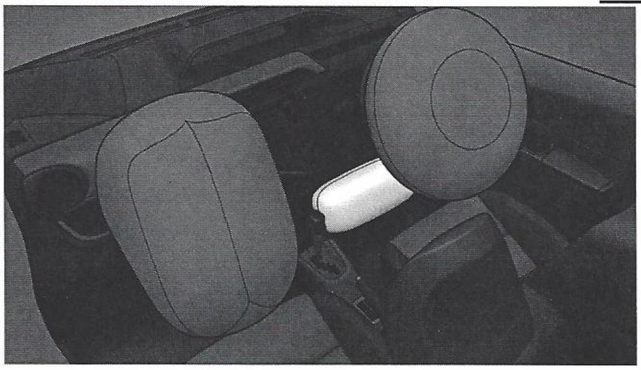


Diagram 3: Knee Airbag - Driver

The knee airbags are available on both the driver and passenger side of the first row. They are designed with two responsibilities. To protect the occupants knees from making contact with the lower dash panel in an accident and help reduce the phenomenon where the occupant slides forward under the seatbelt known as 'submarining'.

SRS COMPONENTS continued...

Side Airbag

Diagram 4: Side Airbag - Driver

The side airbags take on a variety of designs and forms. The major design variation is whether the airbag is designed to protect the Thorax (chest) alone or the Head and Thorax. If coupled with a curtain airbag the side airbag is usually deigned only for the thorax.
Side airbags are available for first and second row outbound passengers and can be located either in the seat backrest outbound bolster or within the door.
Numerous OE and scantool manufacturers reference this component as SAB (Side AirBag) prefixed by a couple of letters to identify its location.

⚠ *Caution:* *Vehicles fitted with seat mounted side airbag must only be fitted with authorised and tested seat covers. Using a normal seat cover will prevent the airbag from exiting the seat correctly and could cause serious injury to the occupant!*

Curtain Airbag

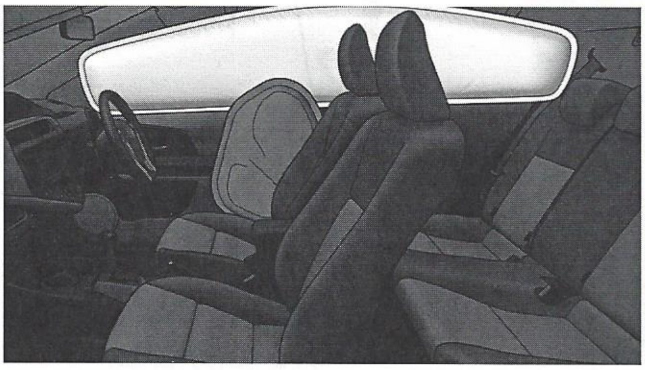


Diagram 5: Curtain Airbag - Driver

The curtain airbags protect the heads of first, second and even third row passengers from coming into contact with the side of the vehicle in side impact collisions and rollovers. The curtain airbag relies heavily on the windows being in the closed position for safe deployment, some manufacturers are using pre-crash detection technologies to close windows prior to deployment.
Numerous OE and scantool manufacturers reference this component as CAB (Curtain AirBag) prefixed by either a L or R to identify its location.

ℹ *Note:* *Capacitors in the SRS Control Module generate approximately 24 Volts for pyrotechnic deployment, while 12 Volts is sufficient to detonate the pyrotechnic increasing the voltage reduces latency (delay)!*

SRS COMPONENTS continued...

Seatbelt Pre-tensioners

Seatbelt pre-tensioners can usually be deployed as part of an airbag deployment strategy or in the case of a minor accident they me deployed without any of the airbags. Initially designed to only be deployed as part of frontal impact collisions manufacturers are now learning the benefits of using seatbelt pre-tensioners in other types of collisions.

Seatbelt pre-tensioners can be found on up to three of the seatbelt points:

- Inertia reel
- Buckle
- Anchor point

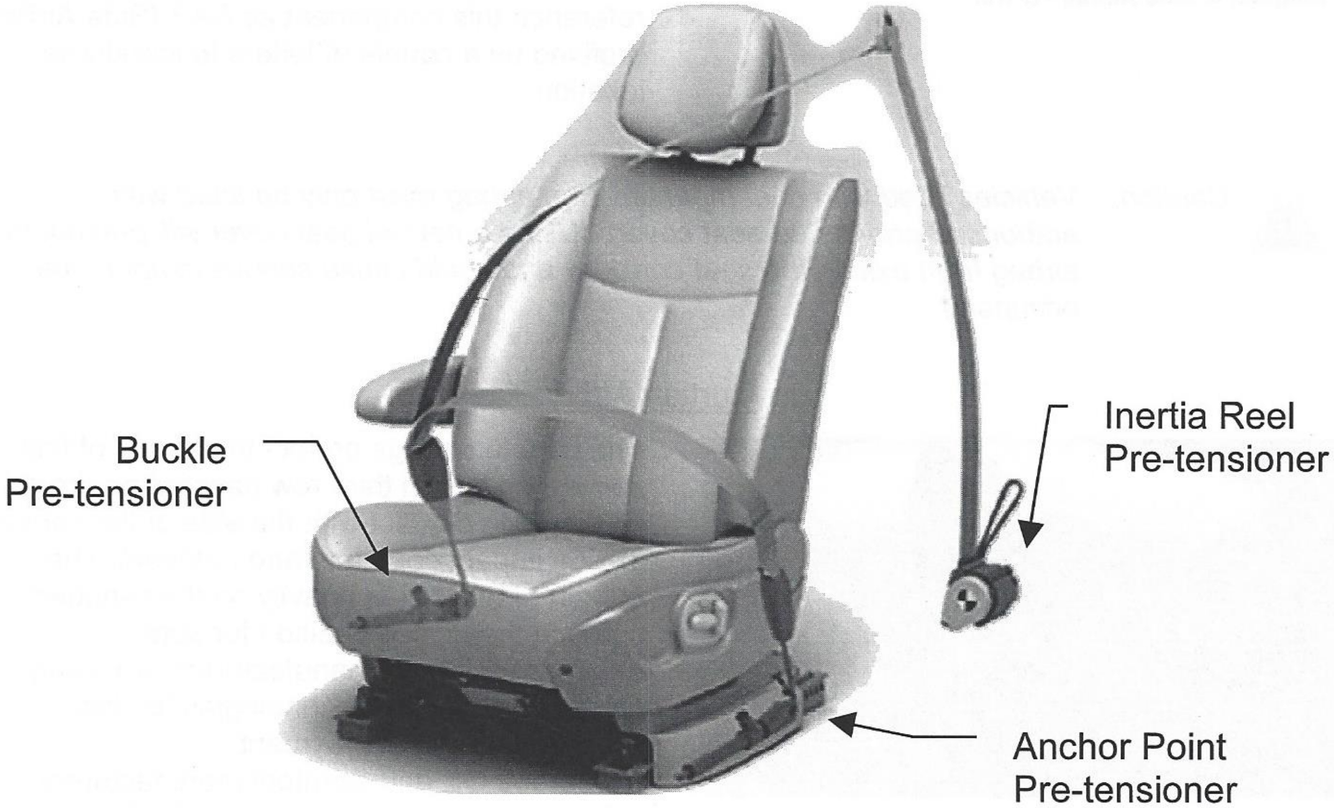


Diagram 6: Seatbelt pre-tensioner options

While there are subtle differences in the way each type of pre-tensioner tightens the belt they all have the same role and that is position the occupant the optimal (safest) position for airbag deployment.

Most vehicles in the Australian market are fitted with only one pre-tensioner on any one seatbelt however a growing number of manufacturers are adopting the use of multiple pre-tensioners.

Seatbelt pre-tensioners have a seatbelt retraction capability of up to 10cm per unit.

SRS COMPONENTS continued...

Battery Isolators

Battery Isolators have been designed to reduce the chance of a vehicle fire after a collision. When equipped the vehicles starting and charging circuits are routed through the isolator, these are the circuits capable of carrying enough current to start a vehicle fire without additional fuel.

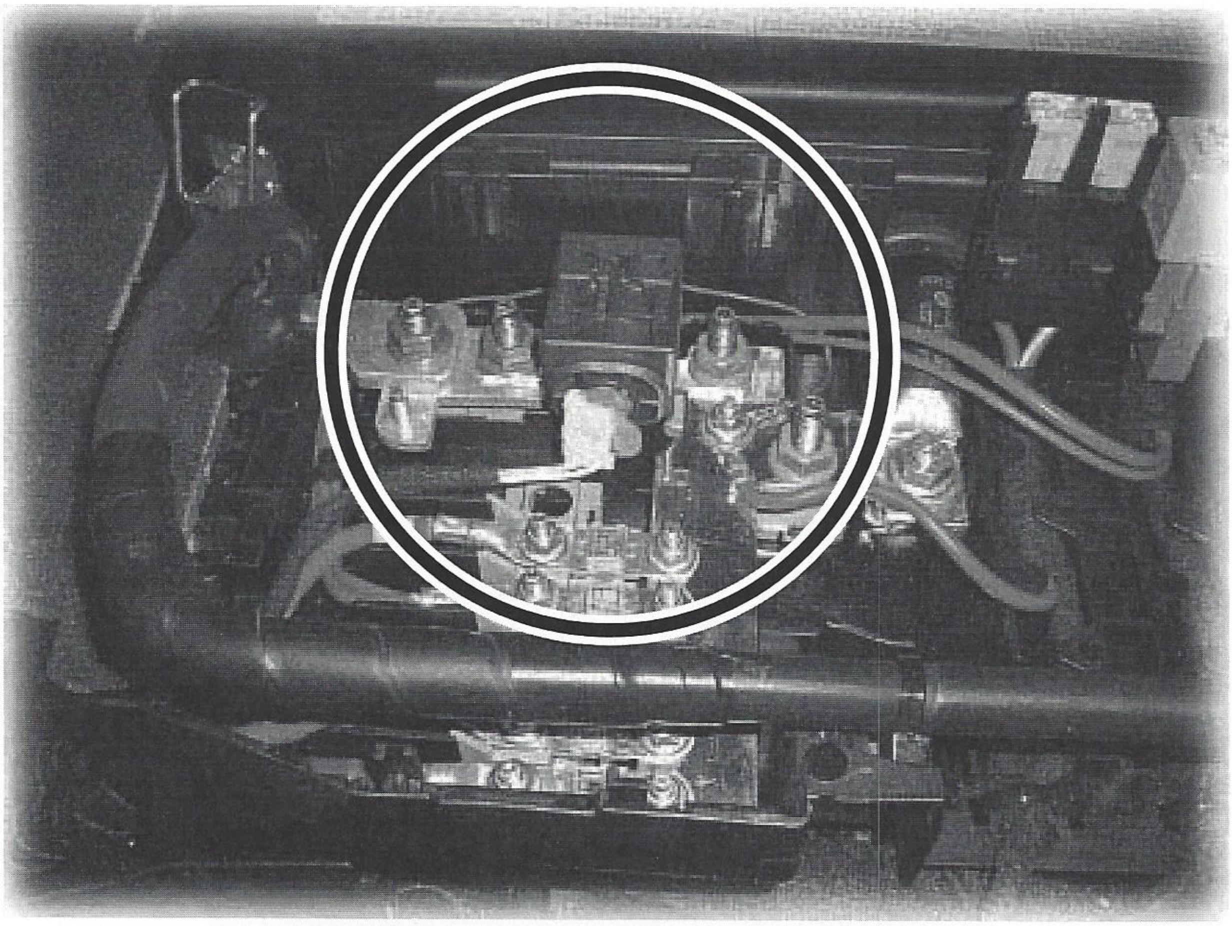


Diagram 7: Audi Q7 – Battery Isolator (located below passenger front seat)

When an airbag or pretensioner is deployed the SRS Control Module detonates the isolator. Unlike a circuit breaker and other 'Post Crash, Additional Safety Features' the battery isolator cannot be reset, to restart the vehicle the minimum repair required is to replace all deployed pyrotechnic devices and the SRS Control Module.

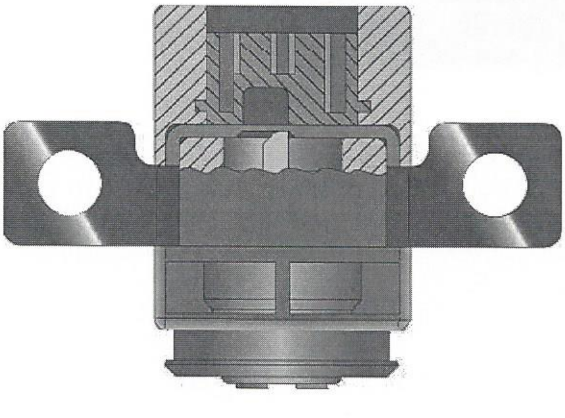


Diagram 8: Volkswagen – Normal state

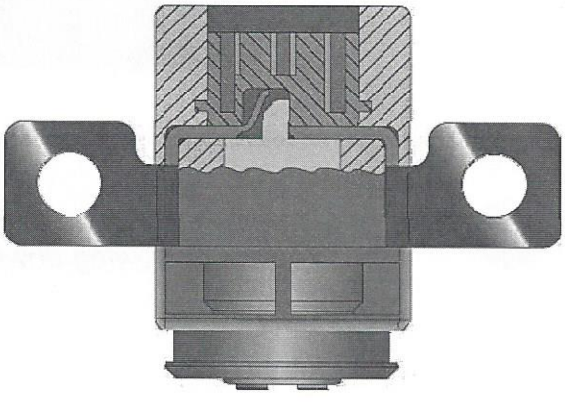


Diagram 9: Volkswagen – Deployed state

SRS COMPONENTS continued...

Crash Sensors

The Crash Sensor (or Impact Sensor) is an essential part component of the Supplementary Restraint Systems. Unlike the airbag which is largely unchanged since its design, the crash sensor has evolved dramatically since the early analogue sensors (see 'Historical SRS' chapter).

There are now two types of crash sensors employed:

- Impact Acceleration Sensors
- Impact Pressure Sensors

Impact Acceleration Sensors

The Impact Acceleration Sensor is a direct replacement for the analogue crash sensor. The modern Impact Acceleration Sensor is a MEMS (Microelectromechanical system) Accelerometer.

MEMS Accelerometers are built using Nano etching technology and can be made to measure acceleration in one, two or four directions.

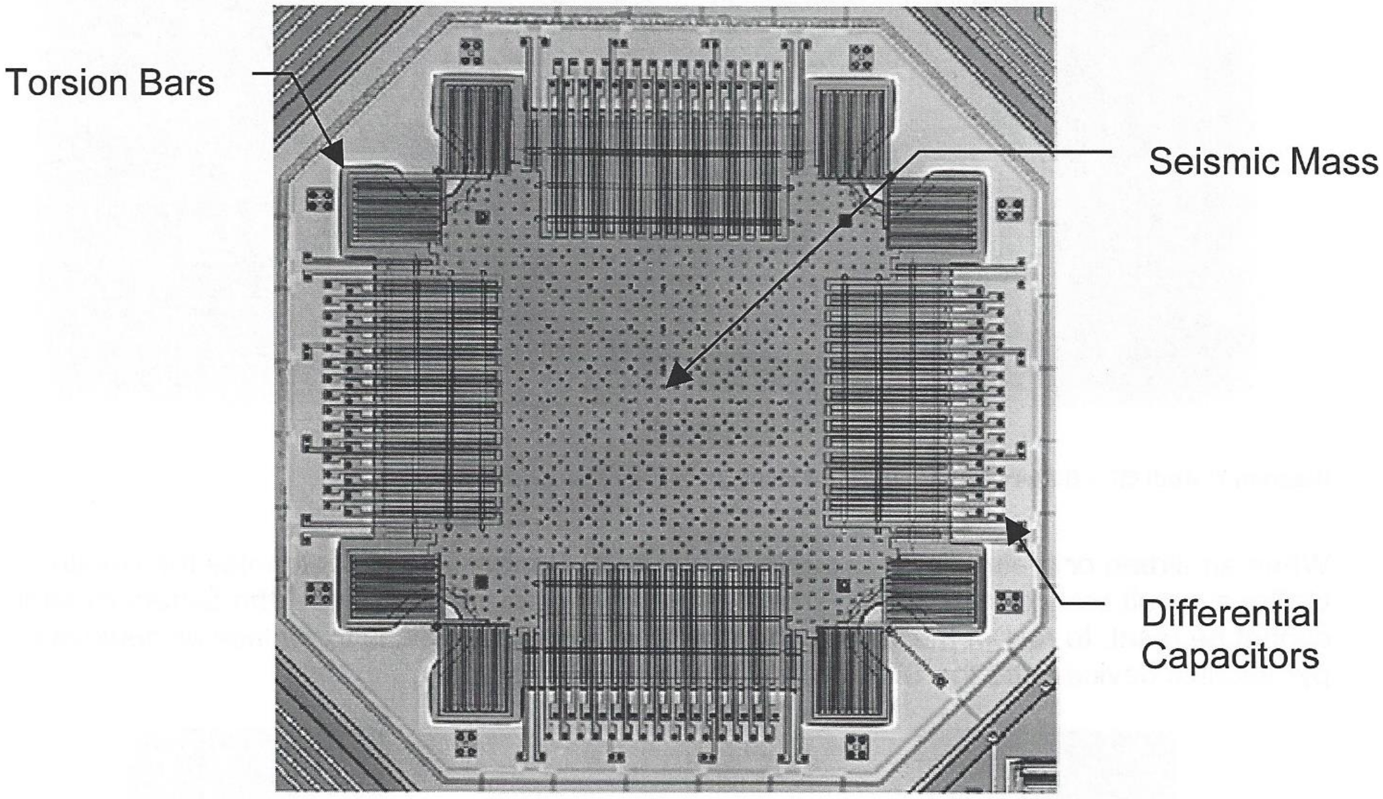


Diagram 10: MEMS Accelerometer - Components

Note: *In scientific terms a change in speed is measured as 'acceleration' even if the object is slowing down!*

SRS COMPONENTS continued...

The torsion bars (or springs) support the seismic mass at each corner and allow it move, the MEMS Accelerometer shown in Diagram 10 has differential capacitors on all four sides allowing it to measure left /right and forward/reverse acceleration. The MEMS Accelerometers used in automotive SRS are capable of measuring up to 500 times the force of gravity (500G).

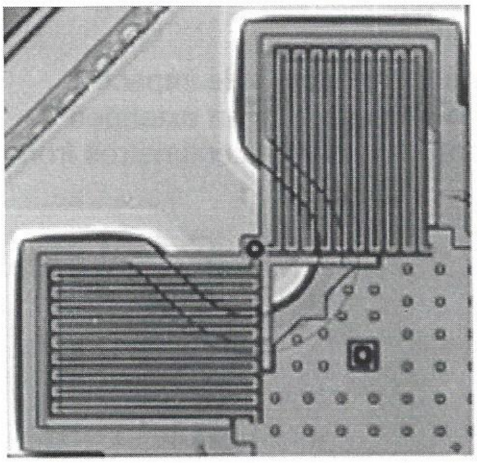


Diagram 11: MEMS Accelerometer – Torsion Bars

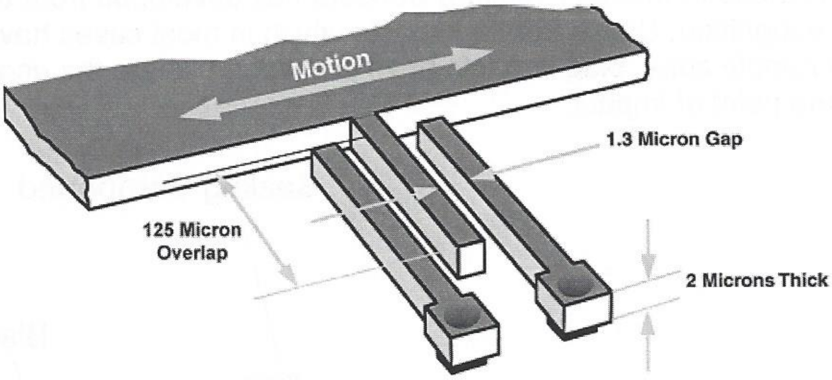


Diagram 12: MEMS Accelerometer – Differential Capacitor

The differential capacitors convert the physical movement of the seismic mass into an electronic signal that can be processed and used by the SRS Control Module to determine the direction and Force of travel. As the fingers connected to the seismic mass move, the gap between them and the fingers that make up the differential capacitors increases and decreases creating a current. The direction and strength of this current, multiplied by the numerous of differential capacitors located around the seismic mass creates the output signal.

And all of this on a sensor that is smaller than a match head!

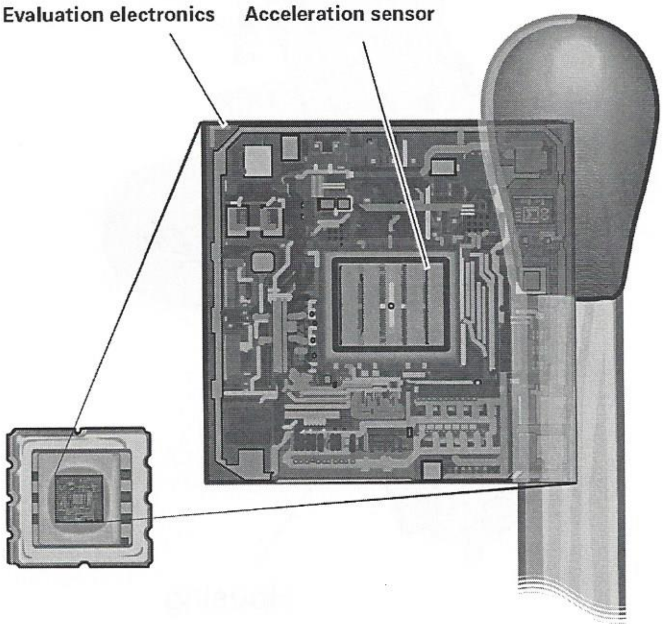


Diagram 13: MEMS Accelerometer – Size comparison

Note: *MEMS Accelerometers are used in many devices, most commonly they are found in smart phones where they provide the information needed for automated screen rotation and many other functions!*

SRS COMPONENTS continued...

Crash Sensors

Impact Pressure Sensors are used to calculate impact severity in an indirect way. When a vehicle is struck by an object, the compression suffered in the impact causes the pressure in the cavity behind the impact zone to increase. When monitored these changes in pressure can be used calculated the area and severity of an impact.

The role of Impact Pressure Sensors has developed from the need for faster side impact recognition. Unlike frontal impacts which in most cases have the advantage of an extended crumple zone, side impacts have to respond where the occupant may only be centimetres from the point of impact.

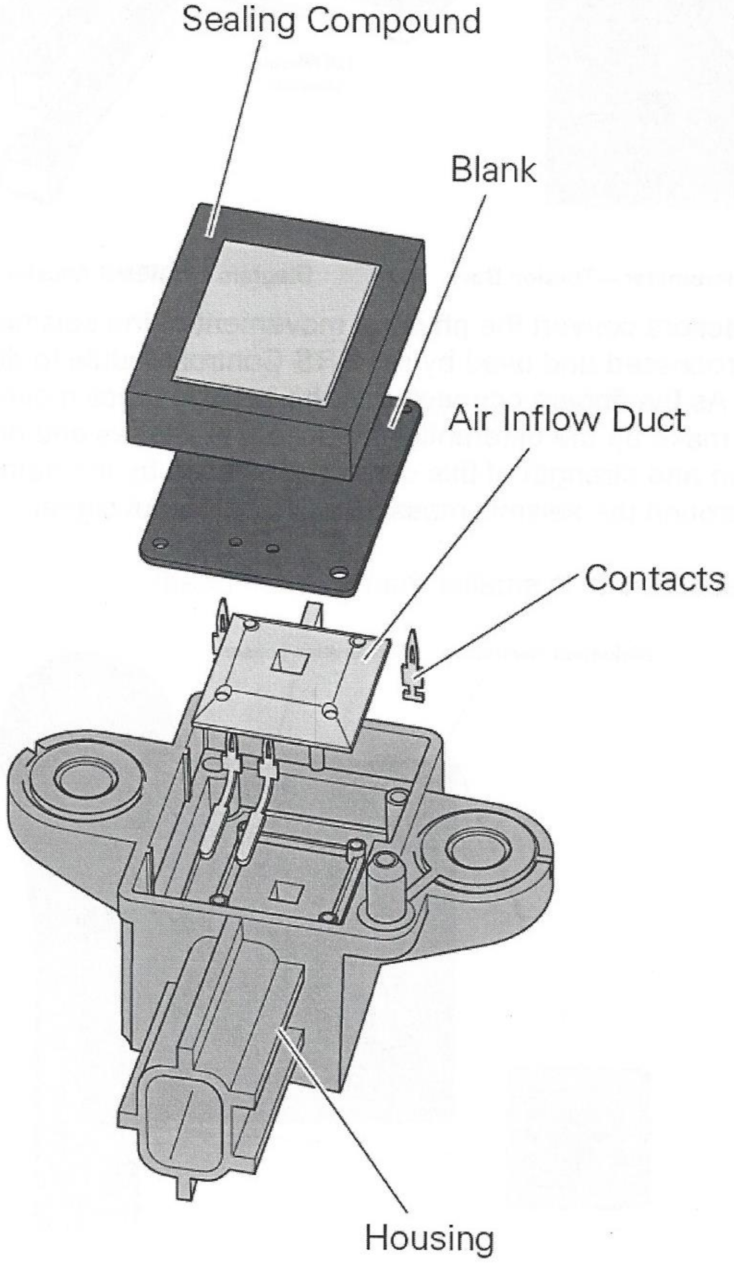


Diagram 14: Volkswagen – Impact Pressure Sensor

Using pressures sensors reduces the inflation response time from 10ms (MEMS Acceleration Sensor) to 2ms. An 8ms saving in a collision is a significant improvement with largely immeasurable benefits for the occupant/s.

SRS COMPONENTS continued...

Impact Pressure Sensors are currently used for side impacts, they are most commonly found in the doors of vehicles fitted with side and curtain airbags however they are sometimes located in the 'A', 'B' or 'C' Pillars.

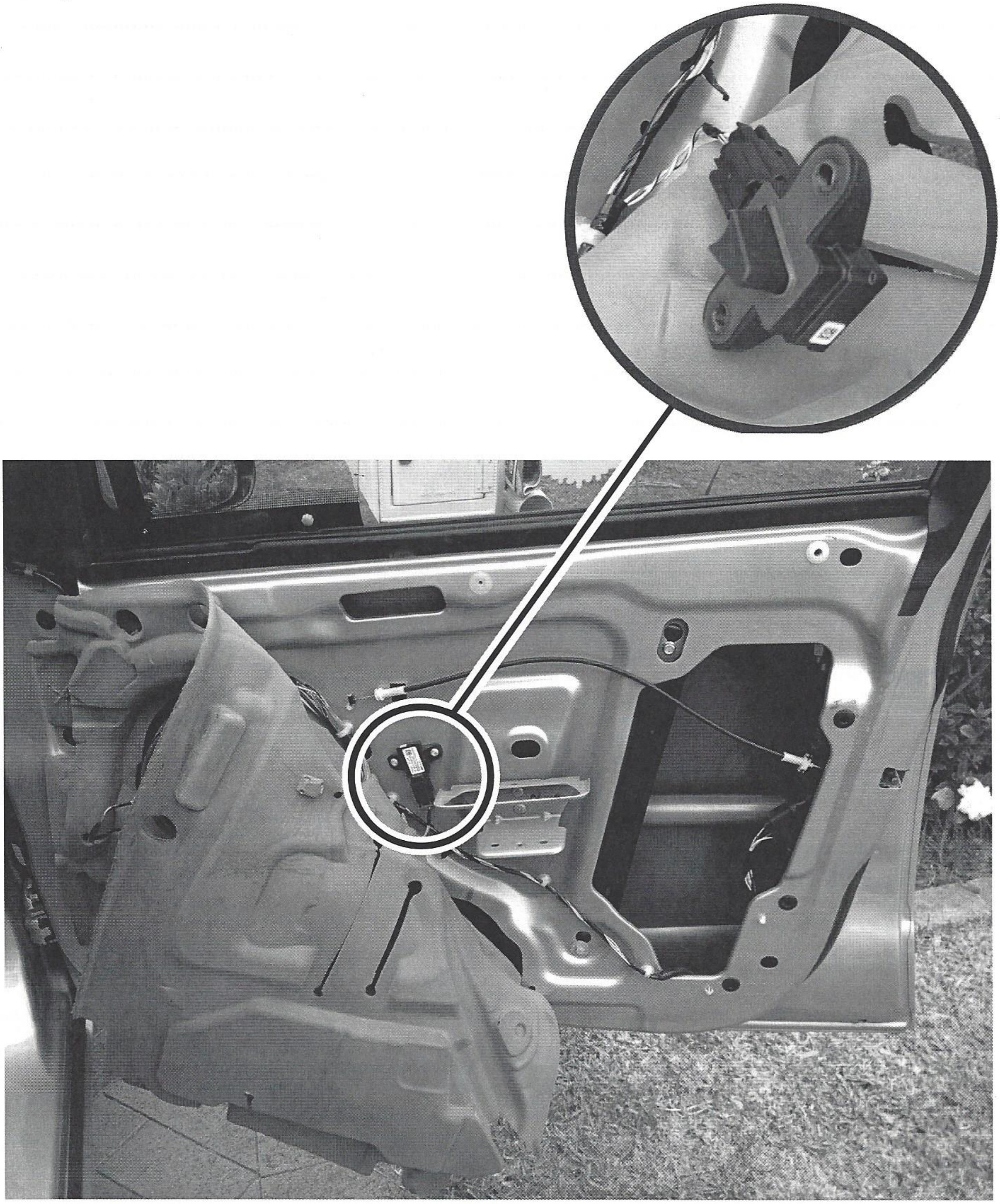


Diagram 15: Ford FG Falcon – Driver Door with trim removed exposing the gasket and Impact Pressure Sensor

⚠ *Caution: The SRS control module monitors pressure changes in the door cavity. Damage to door gasket will adversely affect the signals!*

SRS Deployment Strategies

CHAPTER TOPICS

- ☐ SRS Deployment Strategies

SRS DEPLOYMENT STRATEGIES

Early SRS systems that only contained front airbags had relatively straight forward deployment strategies, most systems required impact to occur 30° either side of the longitudinal centreline and the severity needed to be within preset parameters.

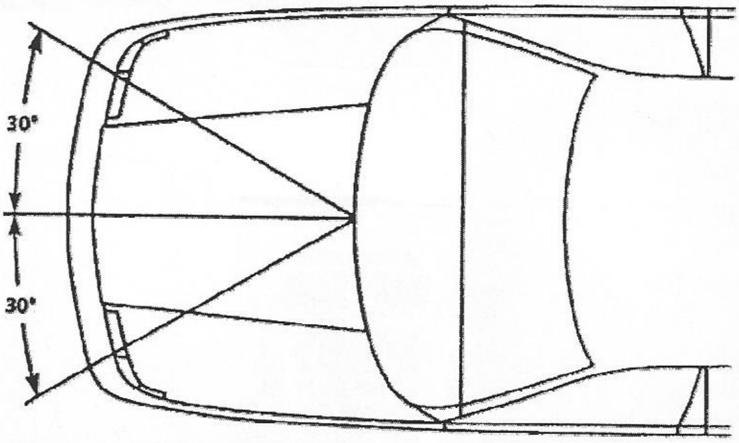


Diagram 16: Impact angle for single airbag deployment

Today's systems usually include more than two airbags plus seatbelt pre-tensioners etc... This has developed highly sophisticated deployment strategies that use all sensors and data available to deploy particular SRS components. These strategies are not only too complex and unnecessary to describe but the strategies themselves are a valuable asset to the OEM and are therefore not published in an effort to maintain a competitive edge over their competitors.

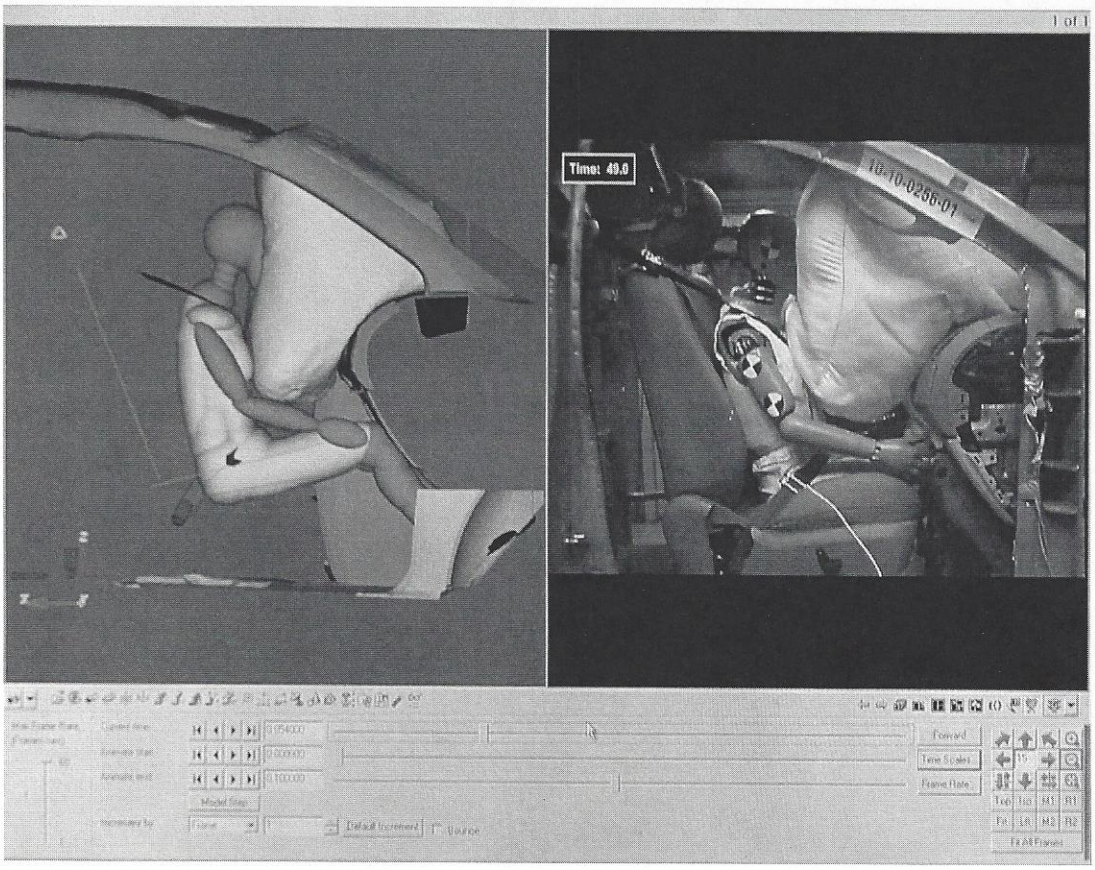

1 of 1
Time: 49.0
10-10-0256-01
Forward
Time Scale
Frame Rate
Model Step
Default Increment
Bounce
Top
Iso
M1
R1
Fr
LR
M2
R2
Fit All Frames

Diagram 17: TRW – Airbag development simulation vs. testing

Note: *For post crash SRS diagnosis, knowing which devices are likely to deploy will guide you quickly through your inspection and diagnosis!*

SRS DEPLOYMENT STRATEGIES continued...

Although detailed strategies cannot be discussed, there are some generalisations that will help to identify which deployable components may have been triggered in an accident.

Collision Type	Typical components for deployment (where fitted)
Frontal Impact	Front Airbags (Driver and Passenger) Knee Airbags Seatbelt Pre-tensioners
Side Impact	Side Airbag Curtain Airbag Seatbelt Pre-tensioners
Rear Impact	Seatbelt Pre-tensioners
Roll Over	Curtain Airbag Seatbelt Pre-tensioners

Table 1: Collision Type – Typical components for deployment

Note: *Just because a component is available for a certain collision type it does not mean that it will be deployed. Factors that may alter deployment include but are not limited to:*

- *Angle of impact*
- *Severity*
- *Steering angle*
- *Seatbelt fitment*
- *Seat occupancy*
- *Seat position*
- *Window position*

Any of these factors may prevent a component from deploying or in the case of dual stage airbags they may adjust the deployment speed.

SRS Diagnosis, Repair & Safety

CHAPTER TOPICS

- ☐ Disabling the SRS
- ☐ Using Diagnostic Flowcharts
- ☐ Squib Deployment & Disposal
- ☐ Wiring Repairs
- ☐ Post Crash Requirements
- ☐ Handling & Storage
- ☐ Additional Safety Features

DISABLING THE SRS

The SRS Control Module incorporates a number of capacitors. Before the SRS can be worked on safely the power supply to the SRS must be terminated and sufficient time must be given for the capacitors to disperse their stored energy.

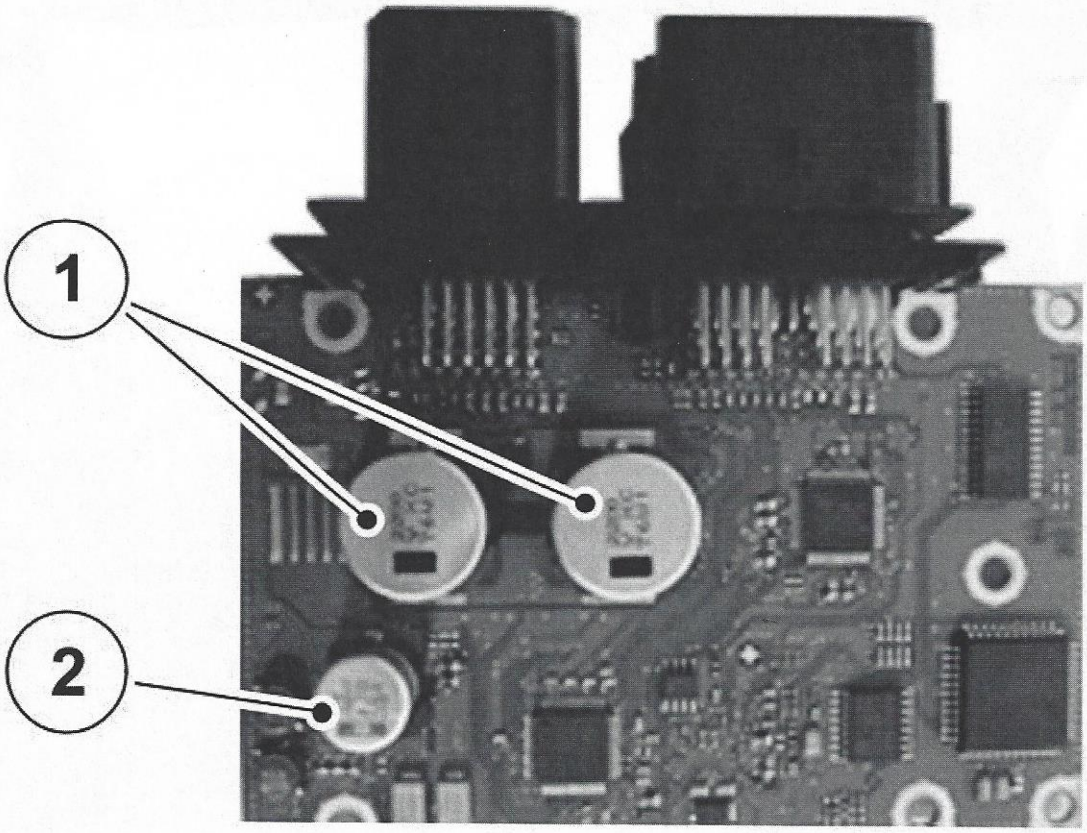


Diagram 18: Capacitors on the PC Board of an SRS Control Module

1. **Deployment Capacitors**
2. **Backup Capacitor**

Deployment Capacitors

The use of deployment capacitors is a benefit rather than a necessity. The deployable devices can be detonated with 12 Volts but by doubling the voltage of the deployment signal the latency (time taken for the signal to travel from the module to the device) is halved. It also ensures that even if voltage drop issues exist enough voltage will reach the deployable device to detonate.

Backup Capacitor

The Backup Capacitor is used to store enough electrical energy to trigger the deployable devices should the vehicles electrical system be disabled at the moment of impact.

Most manufacturers recommend waiting for 1 to 3 minutes after removing the power supply before carry out and testing or repairs on the SRS. The manufacturer's recommendation must always be adhered to. If no OEM information is available, disconnect the negative battery terminal and wait for 10 minutes before commencing.

⚠ *Caution: ALWAYS disconnect the negative battery terminal first, insulate the terminal and secure it where there is no chance of it accidentally making contact with the battery post!*

USING DIAGNOSTIC FLOWCHARTS

Diagnostic flowcharts are designed by the manufacturer from in-depth design knowledge available only to the OEM. They are built using data that is often not published by the manufacturer in any other form.

They can be particularly helpful in electronic diagnosis when there are no Diagnostic Trouble Codes (DTC's) logged as OEM's will often supply a number of these procedures based on fault condition rather than DTC.

Caution: *ALWAYS follow each step of the procedure before passing on to the next. Skipping steps because of an assumption that it is not the fault can lead to misdiagnosis and lost time!*

SQUIB DEPLOYMENT & DISPOSAL

⚠ *WARNING:* *A pyrotechnic device must be deployed before it is disposed of. Once deployed, an SRS component is considered as general waste!*

⚠ *WARNING:* *Dual stage airbags should ALWAYS have the second stage manually deployed in case it did not deploy completely!*

⚠ *WARNING:* *ALWAYS follow OEM disposal procedure!*

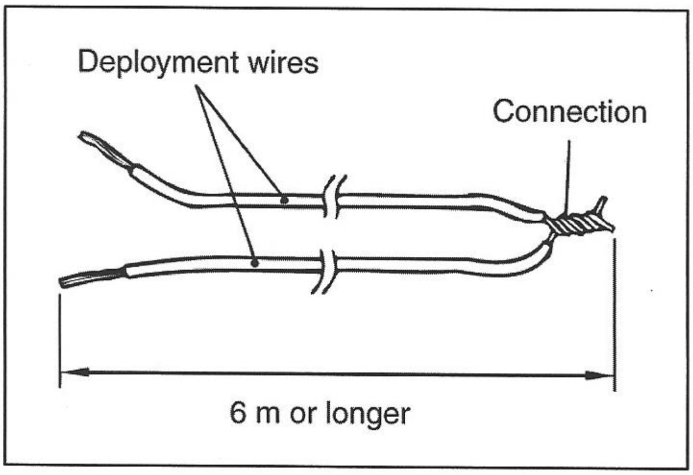
It not only a key safety requirement but also a violation of the law to dispose of a live pyrotechnic device. Therefore all removed SRS deployable components must be stored securely (see: Handling & Storage) and if they are no longer serviceable they must be safely deployed prior to disposal.

There are two general ways of deploying an airbag.
- In situ (in the vehicle)
- Out of the vehicle

Out of the vehicle is the preferred method, In situ should only be used when scrapping a vehicle.

Typical deployment procedure:

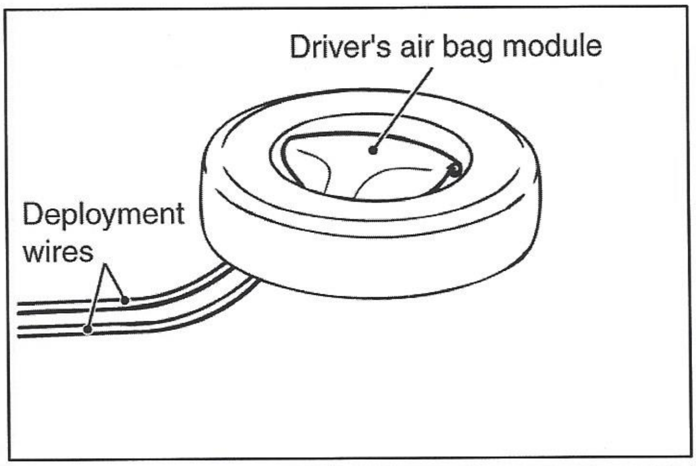
1. Connect 6m long deployment wires

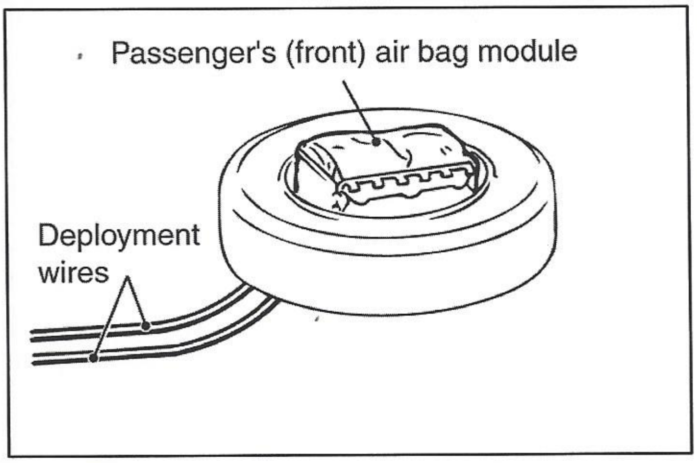


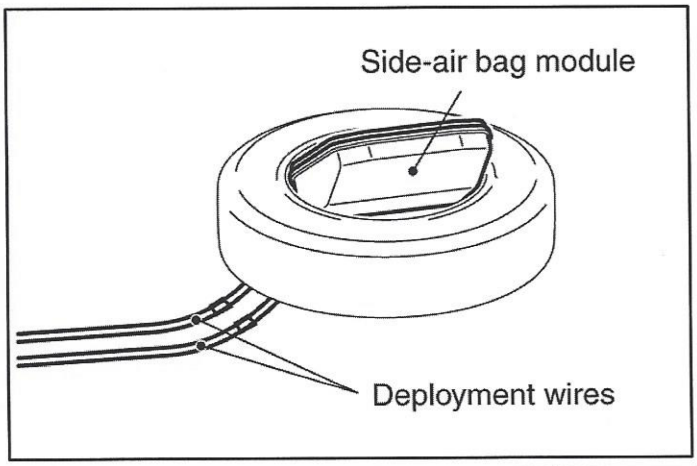
⚠ *Caution:* *Connecting the wires together is an important safety requirement. It stabilises the circuit and prevents accidental deployment from static electricity!*

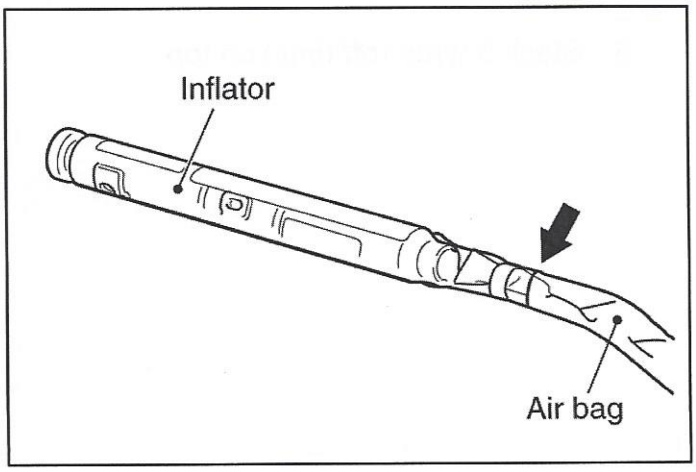
SQUIB DEPLOYMENT & DISPOSAL continued...

2. Using tie wire, mount the component to a wheel rim with a tyre as shown.

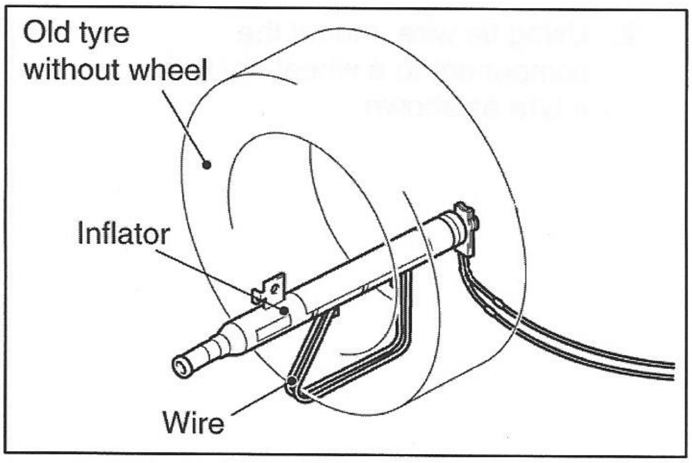

Driver's air bag module
Deployment wires

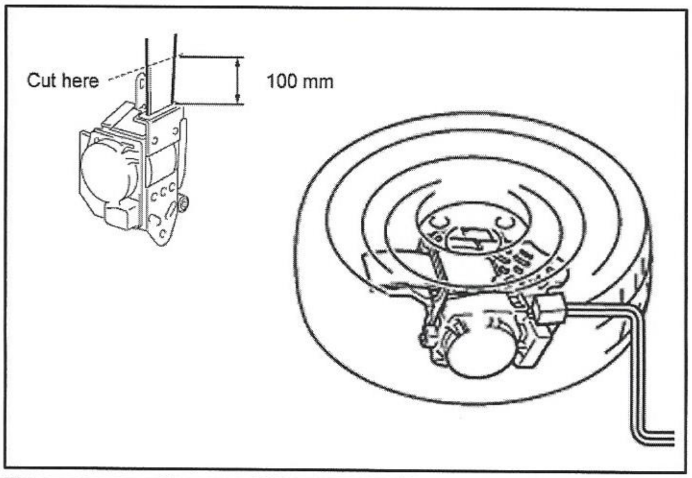

Passenger's (front) air bag module
Deployment wires

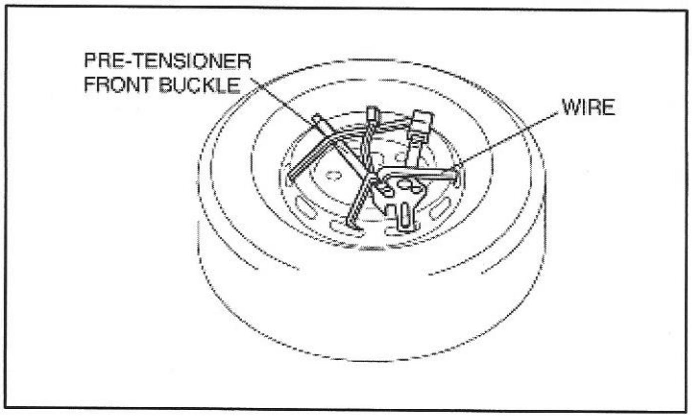

Side-air bag module
Deployment wires


Inflator
Air bag

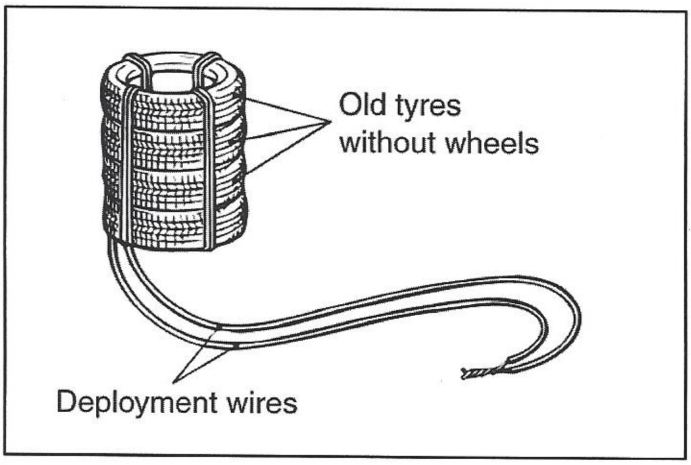
SQUIB DEPLOYMENT & DISPOSAL continued...


Old tyre
without wheel
Inflator
Wire


Cut here
100 mm

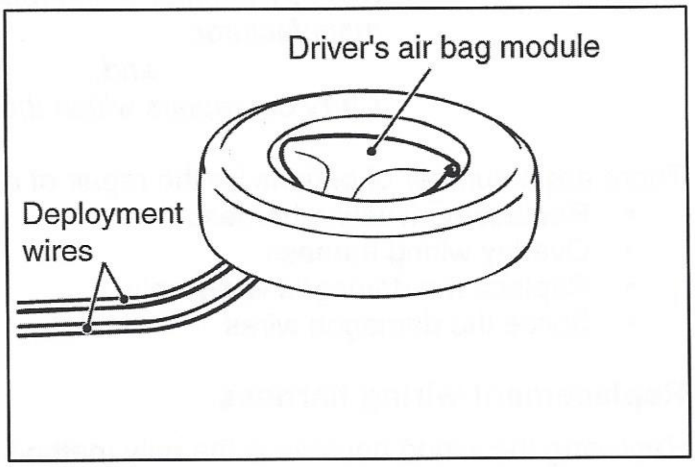

PRE-TENSIONER
FRONT BUCKLE
WIRE

3. Stack 3 tyres (off rims) on top

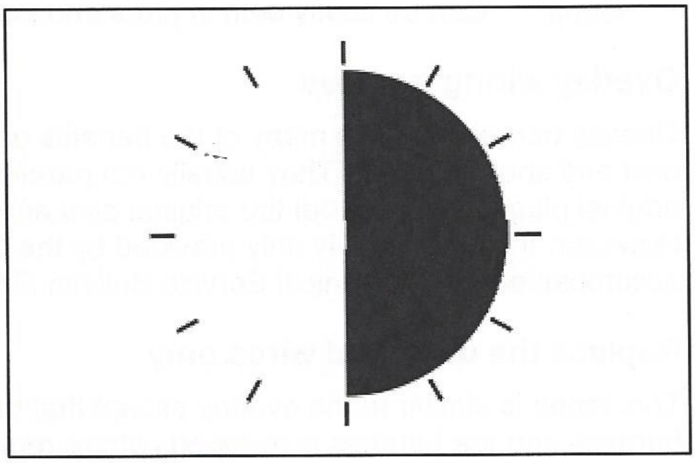

Old tyres
without wheels
Deployment wires

SQUIB DEPLOYMENT & DISPOSAL continued...

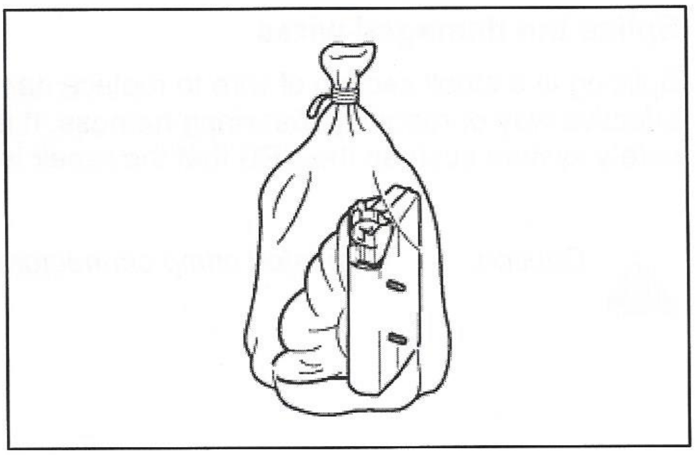
4. Ensure all persons are clear (10m)
5. Connect the wires across a battery
   (Device should now deploy)


Driver's air bag module
Deployment wires

6. Allow device to cool for at least 30 mins



7. Remove it from the rim
8. Wrap firmly in plastic and dispose of in general waste.



WIRING REPAIRS

Caution: *Most manufacturers state that wiring repairs to SRS are forbidden. Do NOT attempt wiring repairs unless it is stated as acceptable by the manufacturer.*

and...

Carry out repairs within the OEM's guidelines!

There are a number of options for the repair of a broken wire.

- Replacement wiring harness
- Overlay wiring harness
- Replace the damaged wires only
- Splice the damaged wires

Replacement wiring harness

Replacing the wiring harness is the only method of repair allowed by some manufacturers.

Pros: You can be confident that the fault has been corrected.
Cons: Can be costly both in parts and labour.

Overlay wiring harness

Overlay harnesses have many of the benefits of replacement wiring harnesses with reduced cost and shorter labour. They usually run parallel with original harness and connect into the original plug by backing out the original pins and inserting the overlay pins.
However, they are usually only provided by the OEM when there is known concern and accompanied by a Technical Service Bulletin (TSB).

Replace the damaged wires only

This repair is similar to the overlay except that the replacement wire is fed into the original harness and the harness is re-taped (where required).

Note: *For a detailed example of this repair, see the Ford G6 Case Study.*

Splice the damaged wires

Splicing in a small section of wire to replace damaged wire can be the most efficient and cost effective way of repairing the wiring harness. It is important when splicing the wiring on a critical safety system such as the SRS that the repair is strong, conductive and durable.

Caution: *Insulated crimp connectors and Scotch Locks are not acceptable!*

WIRING REPAIRS continued...

The following recommendations should be observed with all wiring repairs:

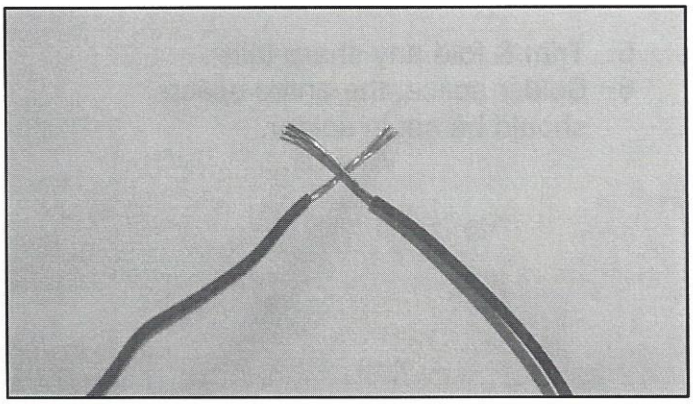
- Do not repair wiring within 50mm of a connector
  (solder will flow up the wires and create a weak point at the back of the connecter)
- Ensure that the replaced wire is of the same type and size (gauge)
- Maintain the original wiring length
- Try to match wiring colour coding
- All joins must be spliced using a Western Union Splice

Western Union Splice

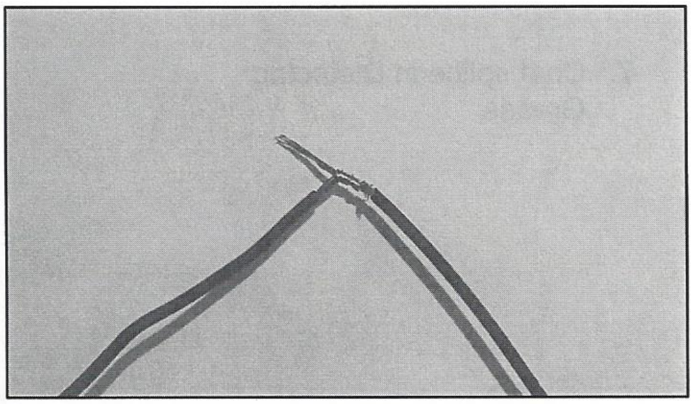
The "Western Union Splice" is regarded to be the strongest and most conductive splice.

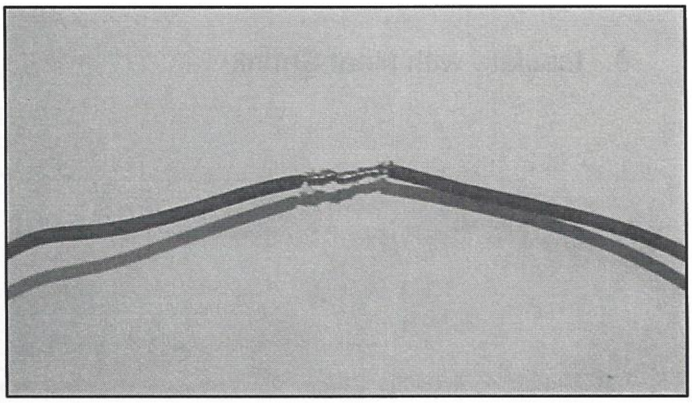
For wire ø1mm (0.75mm²):

1. Strip approx. 20mm from each wire
2. Cross wires



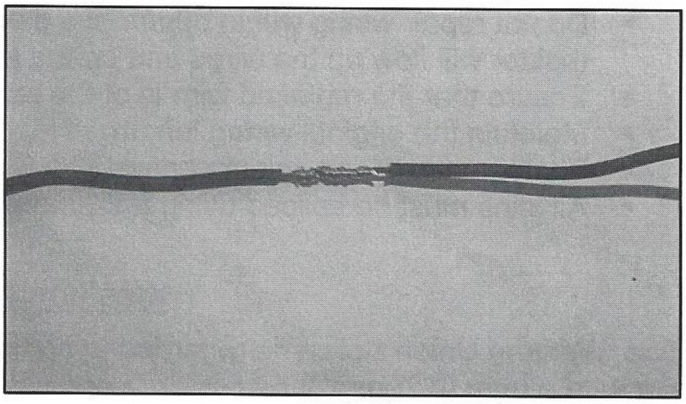
3. Wind each around the other



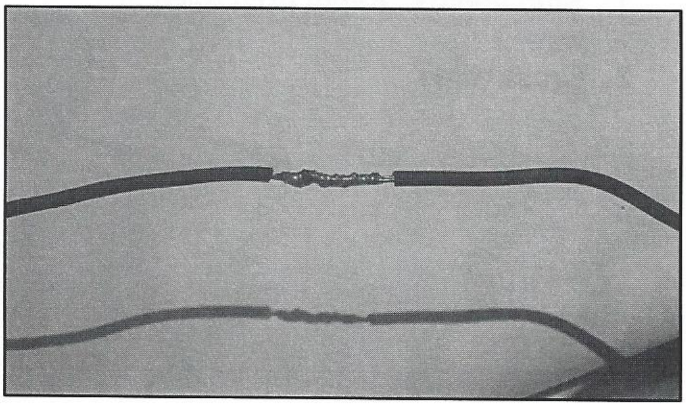


WIRING REPAIRS continued...

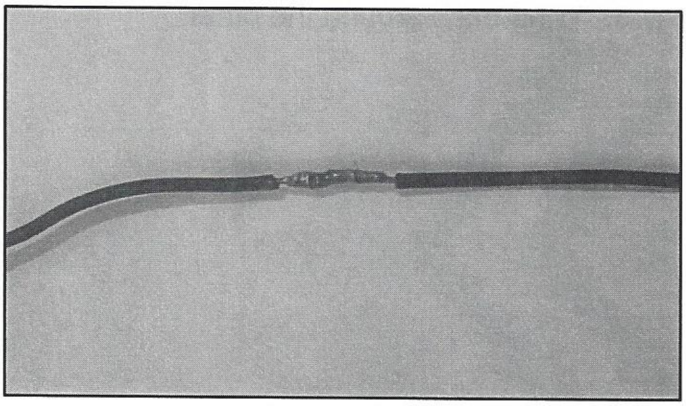
4. Use small amount of tension to set the splice



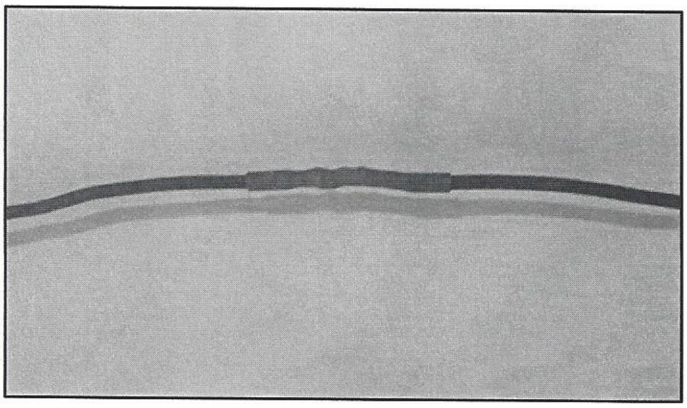
5. Trim & fold any sharp tails
6. Solder splice, the entire splice should be set in solder.



7. Coat splice in Dielectric Grease



8. Insulate with Heat Shrink



POST CRASH REQUIREMENTS

As there are no 'Industry Standards' for post crash repair requirements it is essential to refer to the manufacturers recommendations.

The table below sets out the guidelines for some popular vehicles:

Repair Requirement	Ford FG	Holden VE	Toyota Prado (120)	Mazda2	Hyundai Accent
Control Module	Replace	Replace	Replace	Replace	Replace
Airbags	Deployed	Deployed	Deployed	Deployed	Deployed
Clockspring	Replace	Inspect	Inspect	Inspect	Inspect
Pre-tensioners	Replace entire seatbelt assy.	Deployed	Deployed	Deployed / Inspect	Front: Replace all Side: Replaced deployed
Impact Sensors	Replace All	Replace in impact zone	Front: If damaged Side: In zone	Not Specified	Replace in impact zone
Wiring	Inspect	Inspect	Inspect	Inspect	Replace

Table 2: Post crash requirements

HANDLING & STORAGE

Airbags and seatbelt pre-tensioners are dangerous pyrotechnic devices when handled incorrectly. Following some straight forward safety precautions significantly reduces the risk of unintentional deployment and injury.

Handling

Always store Airbags with the bag facing upward and ensure that items are not placed on top of the airbag.

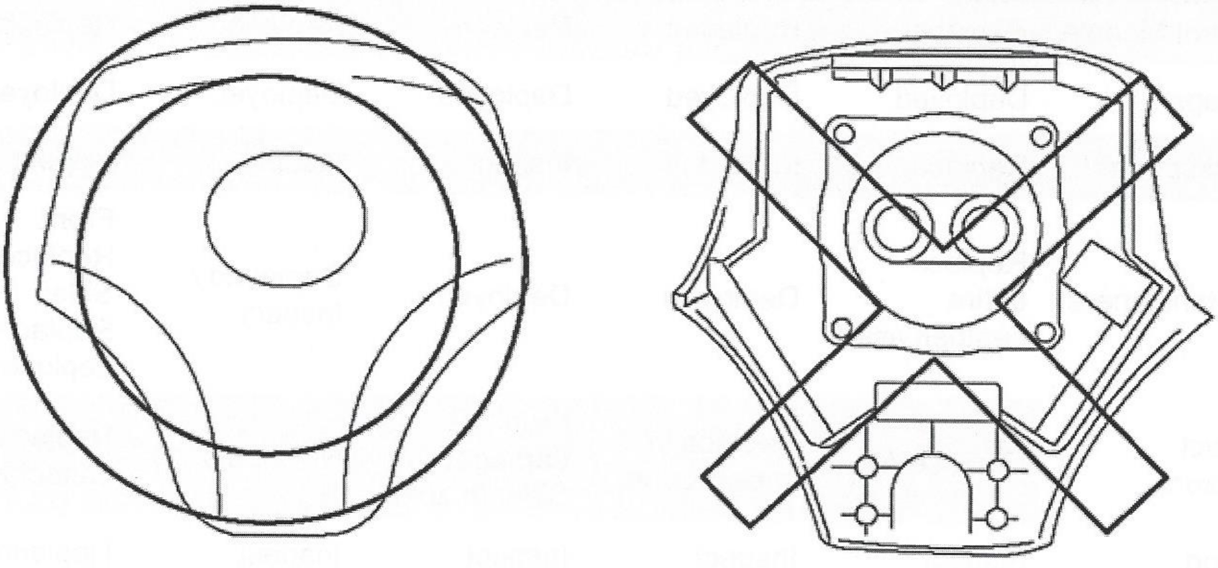


Diagram 19: Correct orientation for airbag storage

Always carry Airbags with the bag facing away from your body

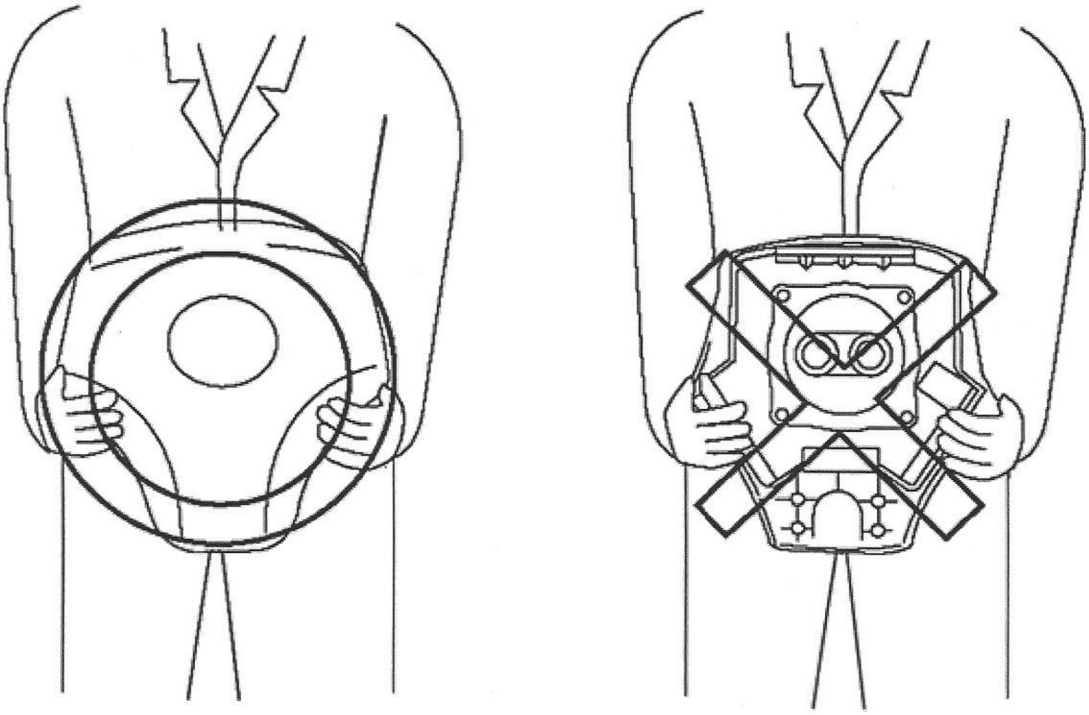


Diagram 20: Correct orientation for carrying an airbag

HANDLING & STORAGE continued...

Storage

If you are storing an SRS component for a short-term while completing repairs the safest storage position is bag up in the luggage compartment on a non-metallic surface.

If you need long-term storage or you need to store numerous components, they should be stored in a designated cabinet

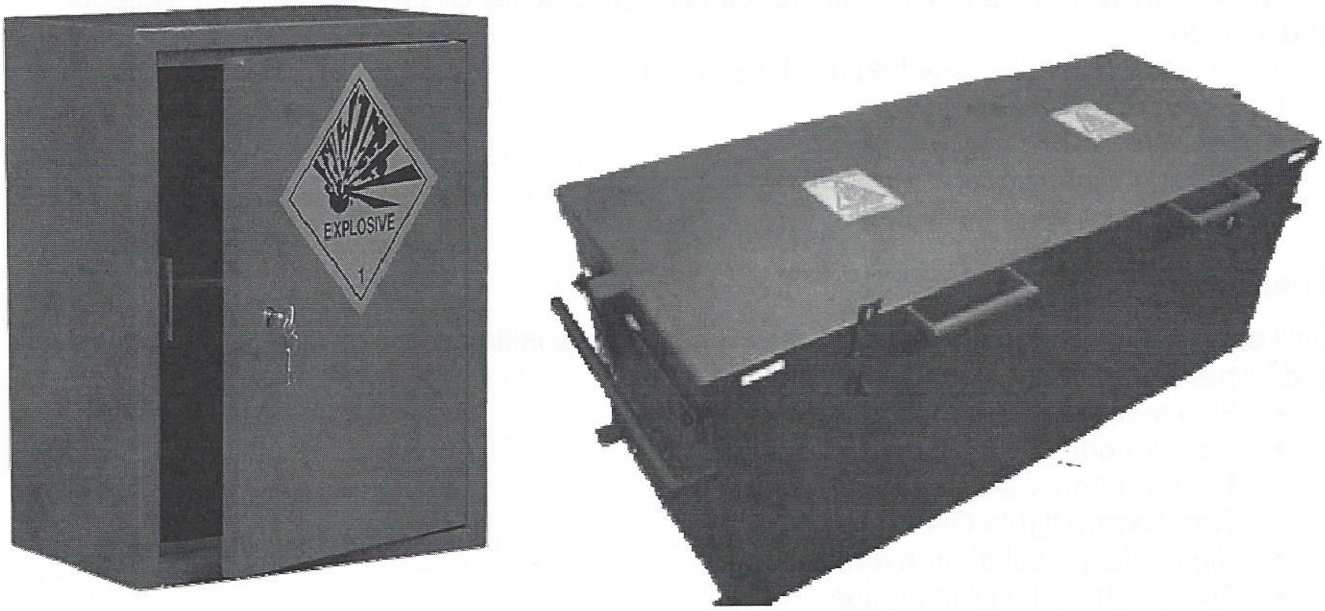


Diagram 21: Wall and floor mounted pyrotechnic storage cabinets

The Drop Ruling

Due to the sensitivity of SRS components most OE manufacturers state that if an SRS component is dropped then it must be inspected and replaced if necessary. As with most specifications, each manufacturer have their own requirements:

Ford:	If dropped inspect the component, if there are ANY signs of damage the component must be replaced.
Holden:	If dropped from a height of 92cm or greater the component must be replaced.
Hyundai:	Any SRS component that has been dropped must be renewed.
Mazda:	If dropped inspect the component, if there are ANY signs of damage the component must be replaced.
Toyota:	Any SRS component that has been dropped must be renewed.

Caution: *The pyrotechnic or squib used to initiate the chemical reaction and fill the airbag has a highly sensitive trigger.*
Dropping an airbag can cause an undetectable fault that may cause it to malfunction!

ADDITIONAL SAFETY FEATURES

There are 2 phases of additional functions

- Pre-crash
- Post-crash

Pre-crash

These functions are not part of the SRS and in fact the SRS receives a signal from the pre-crash system.
The pre-crash systems are additional features of the stability control and/or radar systems and include:

- Activate reversible seatbelt pre-tensioners
- Emergency braking
- Prepare SRS
- Closing windows (and sunroof)
- Keep/Open window slightly

Post-crash

Unlike the pre-crash functions, post-crash functions are initiated from the SRS via CAN-BUS and/or hardwired crash signals, they include:

- Fuel system shut-off
- Unlock doors
- Turn all interior lamps ON
- Turn hazard lights ON
- High voltage isolation (hybrid)
- Brake vehicle if still in motion
- Call emergency services

Case Studies

CHAPTER TOPICS

- ☐ 2006 Toyota Prado
- ☐ 2011 Mazda2
- ☐ 2011 Ford FG G6
- ☐ 2009 Holden Combo
- ☐ 2013 Hyundai Accent

CASE STUDY #1 - TOYOTA

Vehicle: 2006 Toyota Prado
GRJ120 4.0L V6

Complaint 1: Vehicle has never been involved in an accident, SRS light continuously ON while driving.

Condition: SRS Lamp is ON.

CASE STUDY #1 - TOYOTA continued...

Basic Inspection:

- A visual check of the visible SRS components appeared normal.
- The battery and charging system were operating normally.
- A DTC check found no codes

CASE STUDY #1 - TOYOTA continued...

Detailed Inspection:

DIAGNOSTICS - SUPPLEMENTAL RESTRAINT SYSTEM

SRS WARNING LIGHT CIRCUIT MALFUNCTION (ALWAYS LIGHT UP, WHEN IGNITION SWITCH IS ACC OR LOCK POSITION)

CIRCUIT DESCRIPTION

The SRS warning light is located on the combination meter.
When the SRS is normal, the SRS warning light lights up for approx. 6 seconds after the ignition switch is turned from the LOCK position to ON position, and then turns off automatically.
If there is a malfunction in the SRS, the SRS warning light lights up to inform the driver of the abnormality.
When terminal TC and CG of the DLC3 are connected, the DTC is displayed by blinking the SRS warning light.
The airbag warning light on the combination meter assy stay when;

- The fitting of the connector of the airbag sensor assy center is incomplete
- The wire harness between the airbag sensor assy center and the combinatio meter assy has a short with B+
- The combination meter assy malfunctions.

CASE STUDY #1 - TOYOTA continued...

Detailed Inspection:

DIAGNOSTICS - SUPPLEMENTAL RESTRAINT SYSTEM

INSPECTION PROCEDURE

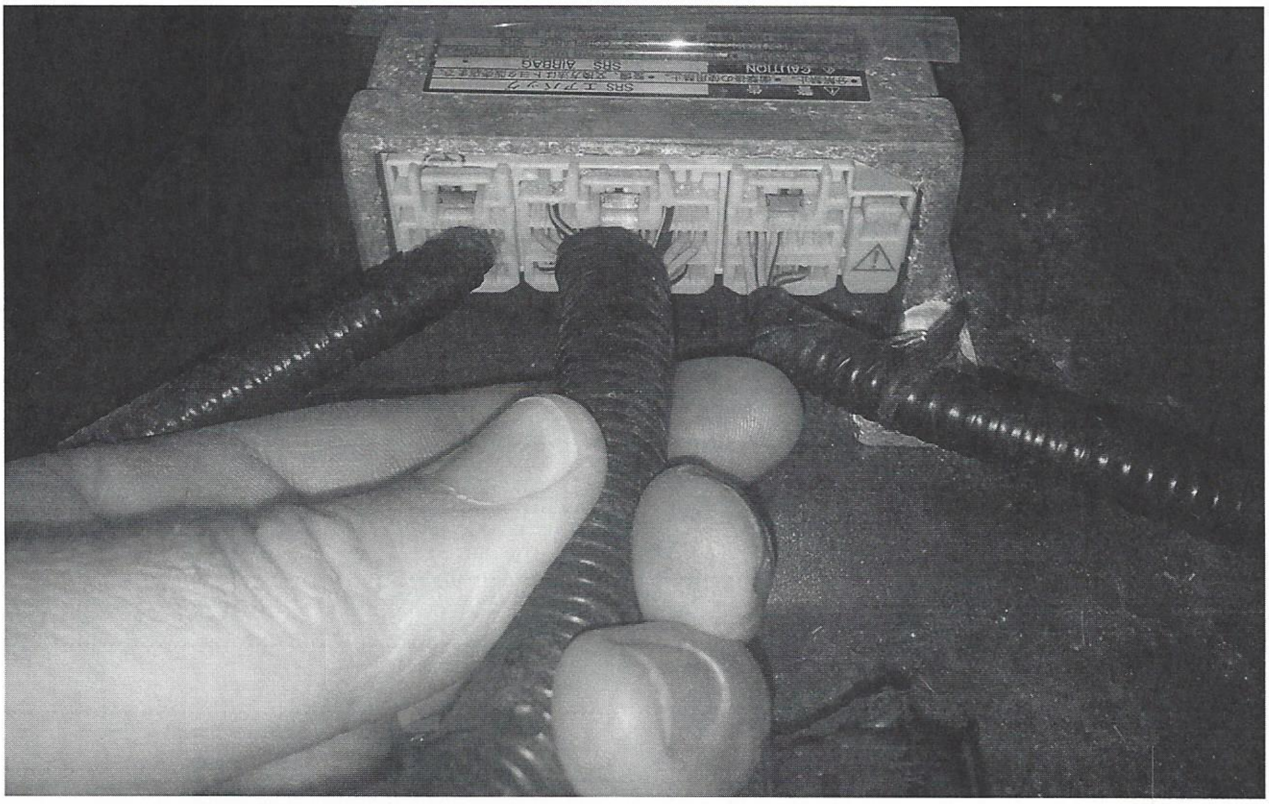
1	CHECK CONNECTOR

(a) Disconnect the negative (–) terminal cable from the battery, and wait at least for 90 seconds.

(b) Check the connection of the airbag sensor assy center connecctors.

NG > **CONNECT CONNECTORS**

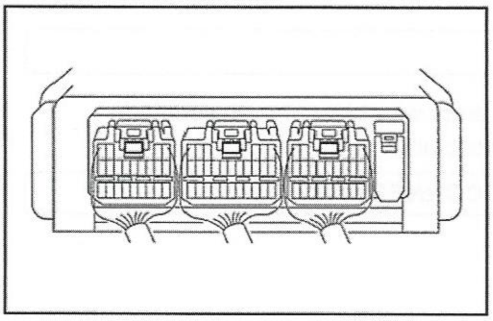
OK



CASE STUDY #1 - TOYOTA continued...

Detailed Inspection:

2 PERFORM A VISUAL CHECK OF THE DISCONNECTION DETECTION PIN



(a) Dissconnect the negative (–) terminal cable from the battery, and wait at least for 90 seconds.

(b) With 3 connectors connected to the airbag sensor assy center, place tester leads onto any 2 or 3 disconnection detection pins and check for continuity.

OK:

Continuity

NG → **REPLACE AIRBAG SENSOR ASSY CENTER CONNECTOR**

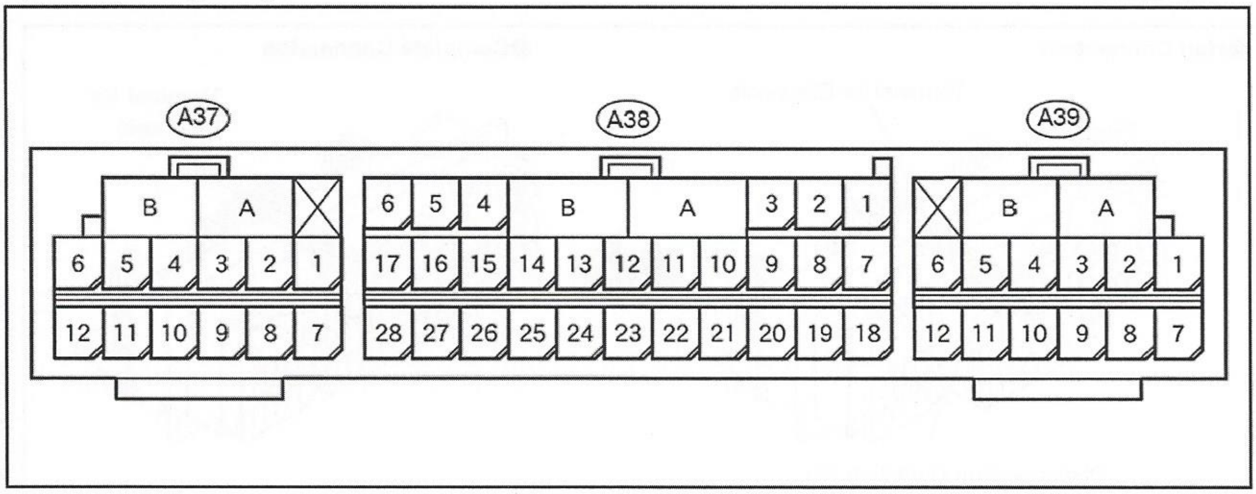
OK

CASE STUDY #1 - TOYOTA continued...

DIAGNOSTICS – SUPPLEMENTAL RESTRAINT SYSTE

TERMINALS OF ECU

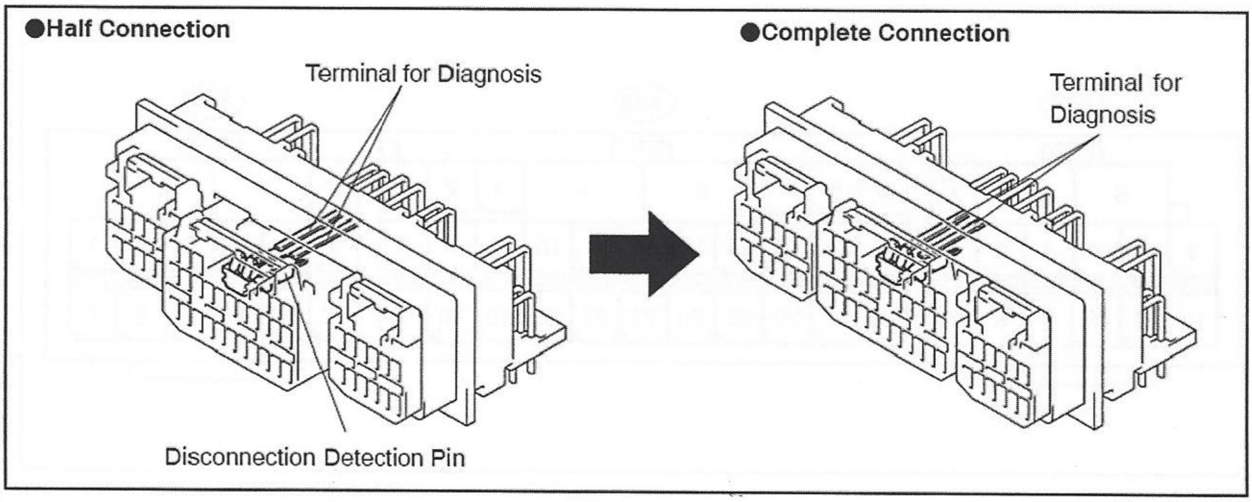
w/o Side Airbag Assy:

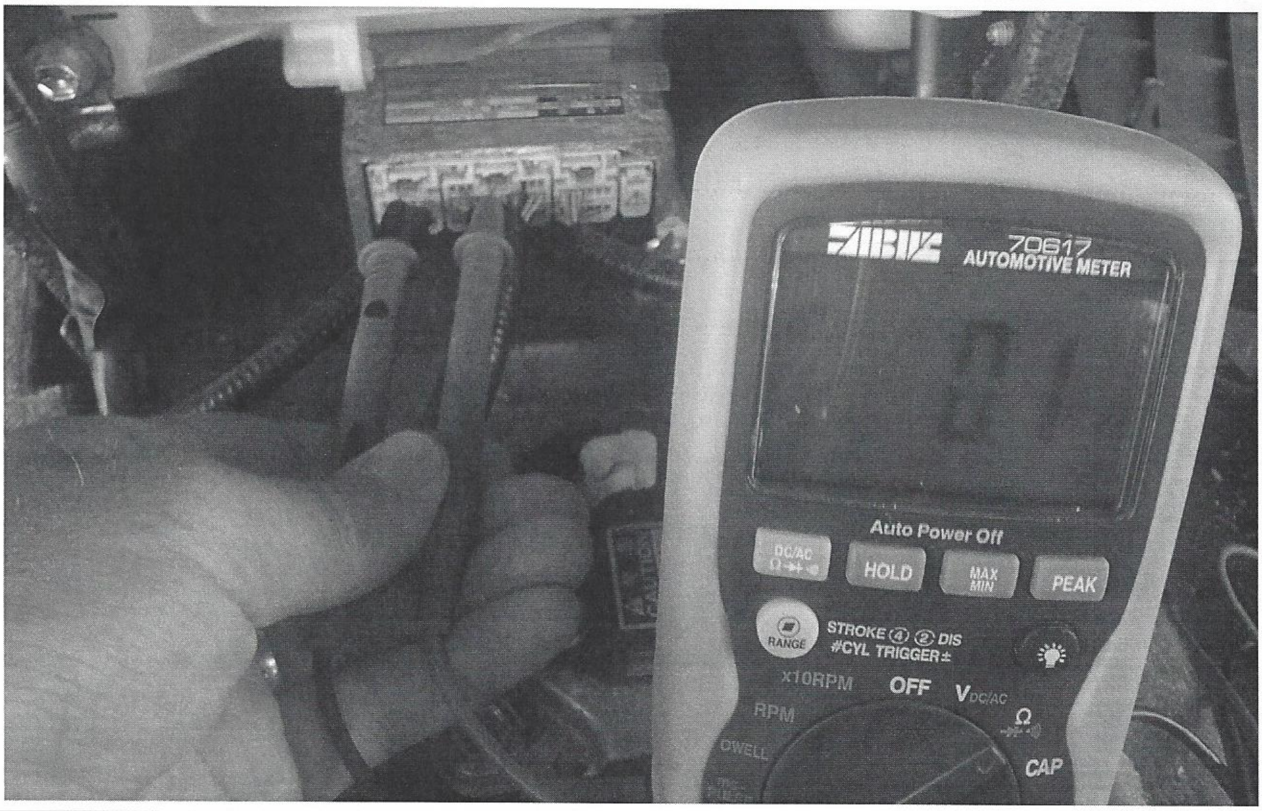

A37
B
A
6 5 4 3 2 1
12 11 10 9 8 7
A38
6 5 4
B
A
3 2 1
17 16 15 14 13 12 11 10 9 8 7
28 27 26 25 24 23 22 21 20 19 18
A39
B
A
6 5 4 3 2 1
12 11 10 9 8 7

Terminal No.	Symbol	Terminal Name
A	–	Electrical Connector Check Mechanism
B	–	Electrical Connector Check Mechanism

CASE STUDY #1 - TOYOTA continued...

Detailed Inspection:

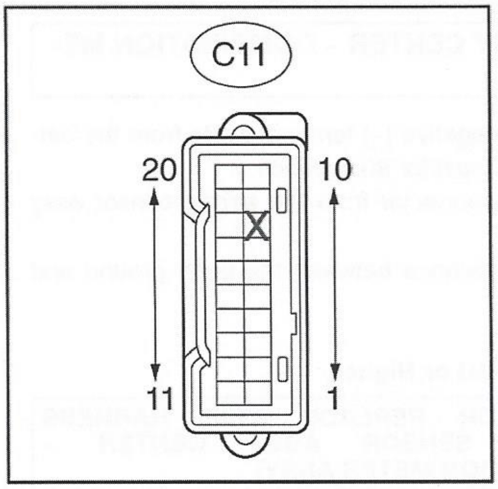

●Half Connection
Terminal for Diagnosis
Disconnection Detection Pin
●Complete Connection
Terminal for Diagnosis


70617 AUTOMOTIVE METER
Auto Power Off
DC/AC
HOLD
MAX MIN
PEAK
RANGE
STROKE ④ ② DIS
#CYL TRIGGER±
x10RPM
OFF
VDC/AC
Ω
RPM
DWELL
CAP

CASE STUDY #1 - TOYOTA continued...

Detailed Inspection:

3 CHECK COMBINATION METER ASSY


C11
20
10
11
1
X

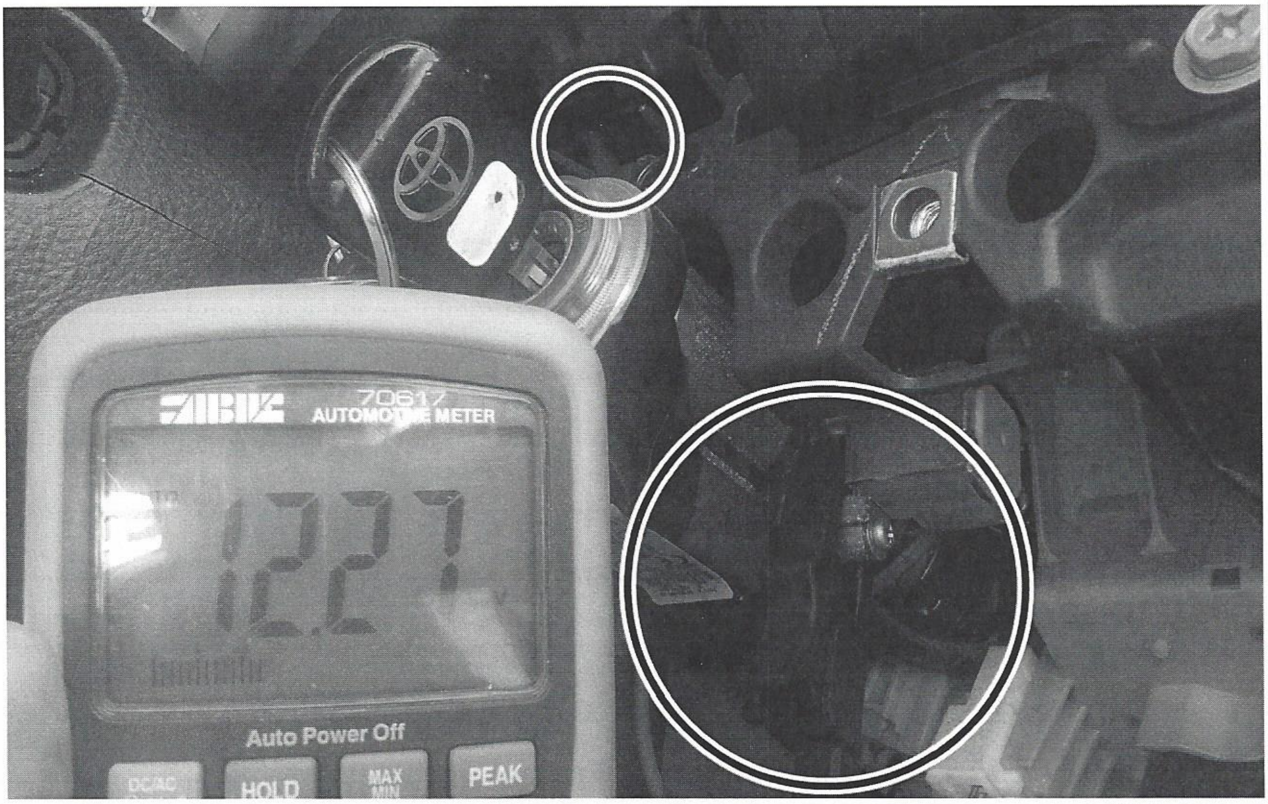
(a) Remove the combination meter assy
(b) Connect the negative (–) terminal cable to the battery.
(c) Turn the ignition switch to ON.
(d) Measure the voltage between the body ground and terminal C11–8 of the combination meter assy.

OK:

Voltage: 8 – 16 V

NG → **REPAIR OR REPLACE COMBINATION METER ASSY**

OK

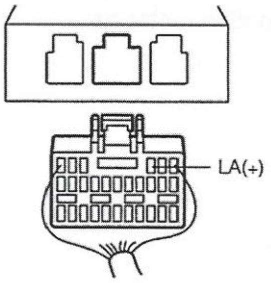

70617
AUTOMOTIVE METER
12.27
Auto Power Off
DC/AC
HOLD
MAX MIN
PEAK

CASE STUDY #1 - TOYOTA continued...

Detailed Inspection:

DIAGNOSTICS - SUPPLEMENTAL RESTRAINT SYSTEM

4	**CHECK WIRE HARNESS (AIRBAG SENSOR ASSY CENTER – COMBINATION METER ASSY)**



(a) Disconnect the negative (–) terminal cable from the battery, and wait at least for 90 seconds.

(b) Disconnect the connector from the airbag sensor assy center.

(c) Measure the resistance between the body ground and terminal LA.

OK:

Resistance : 1 MΩ or Higher

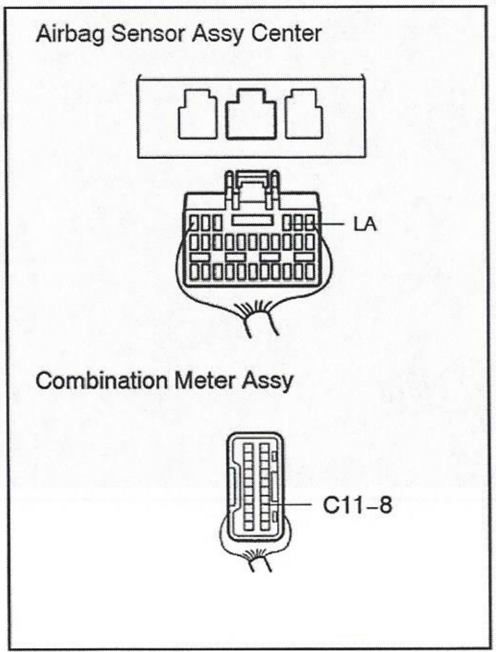
NG → **REPAIR OR REPLACE WIRE HARNESS (AIRBAG SENSOR ASSY CENTER – COMBINATION METER ASSY)**

OK

CASE STUDY #1 - TOYOTA continued...

Detailed Inspection:

5	**CHECK WIRE HARNESS (AIRBAG SENSOR ASSY CENTER – COMBINATION METER ASSY)**


Airbag Sensor Assy Center
LA
Combination Meter Assy
C11–8

(a) Measure the resistance between terminal C11–8 of the combination meter assy connector and terminal LA of the airbag sensor assy center connector.

OK:

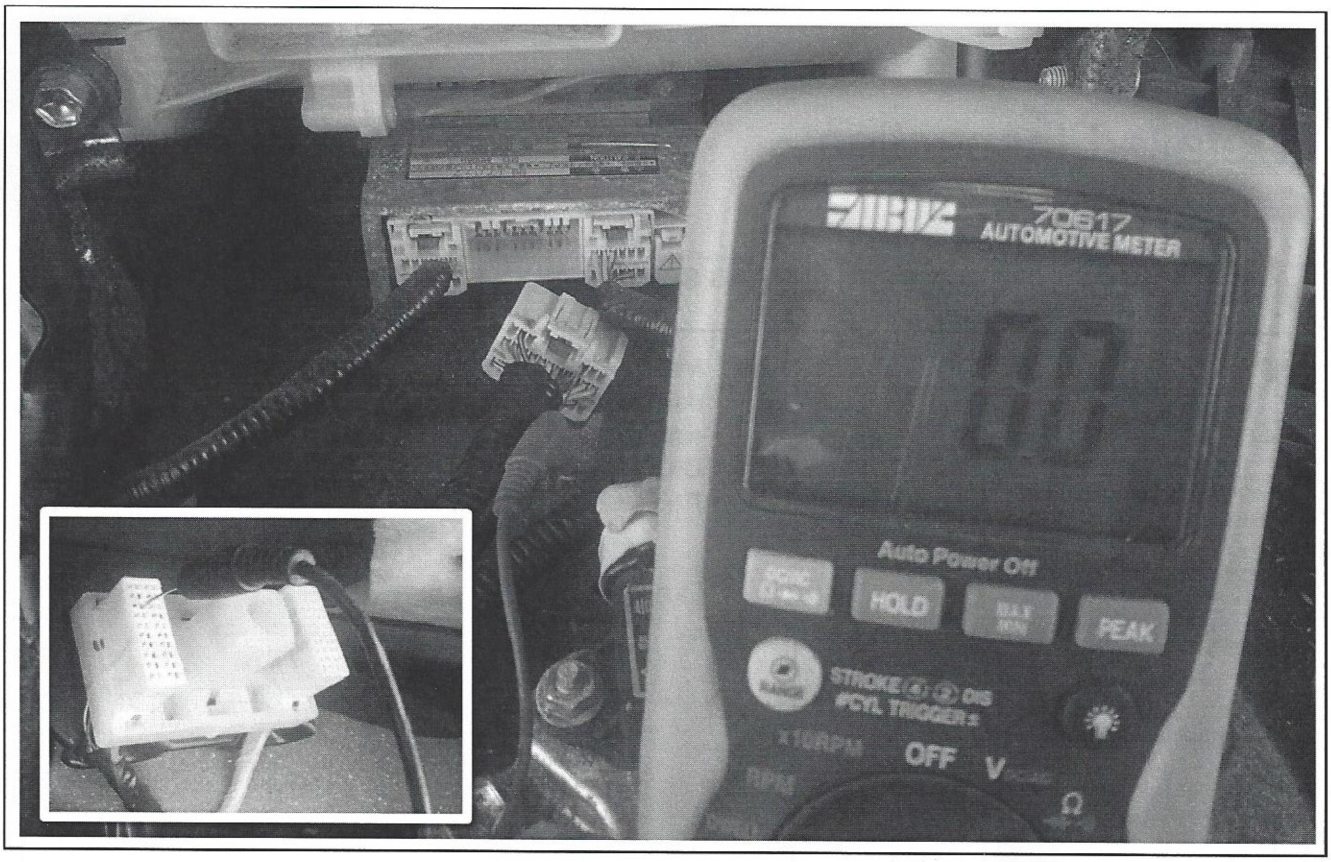
Resistance: Below 1 Ω

NG → **REPAIR OR REPLACE WIRE HARNESS (AIRBAG SENSOR ASSY CENTER – COMBINATION METER ASSY)**

OK ↓

REPLACE AIR BAG SENSOR ASSY CENTER

CASE STUDY #1 - TOYOTA continued...



Diagnosis

Tests one through five have proven that:

- The Instrument Cluster is function normally
- The wiring harness has continuity
- The power circuits are operative
- The ground circuits are sound
- All connectors are seated correctly

With the help of the diagnostic flow chart we have proven that all components (excluding the SRS Control Module) that may cause the SRS Lamp to illuminate are functioning normally. The diagnosis is a faulty SRS Control Module.

Note: *It is quite common for a failing control module to cause system faults without logging codes, cause full system failure or even log multiple codes mistakenly. It is only after proving that all other circuits are serviceable that a a control module should be replaced under these conditions!*

CASE STUDY #1 - TOYOTA continued...

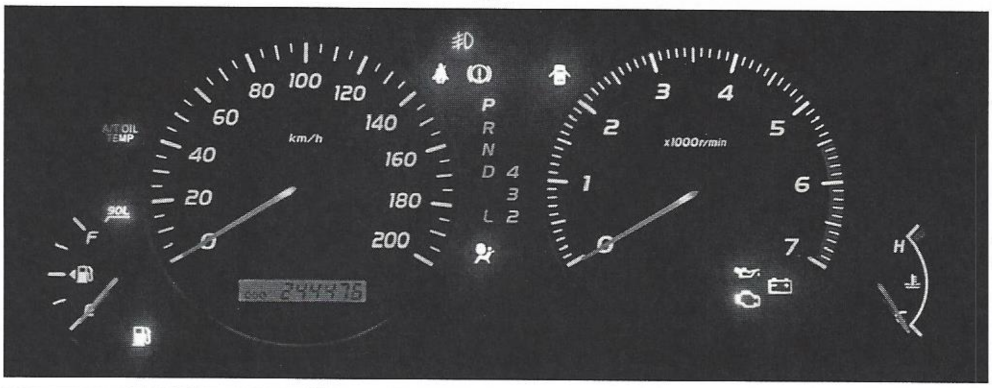
Perform Repair:

- Disconnect battery and wait for 90 Seconds
- Remove the 3 connectors
- Remove the 3 mounting bolts
- Replace SRS Control Module
  (offset bolts ensure correct orientation)
- Tighten the 3 mounting bolts to 17.5Nm
- Connect the 3 connectors
- Reconnect the battery

CASE STUDY #1 - TOYOTA continued...

Verify Repair:

- Check DTC's and erase if necessary
- Turn the ignition ON
- Check that the Airbag light illuminates for 6 seconds and the extinguishes


20
40
60
80
100
120
140
160
180
200
km/h
A/T OIL TEMP
F
E
P
R
N
D 4
3
L 2
1
2
3
4
5
6
7
x1000r/min
H
C
244476

CASE STUDY #2 - MAZDA

Vehicle: 2011 Mazda2
1.5L I4

Complaint: SRS light is ON while driving.

Condition: SRS Lamp is ON.

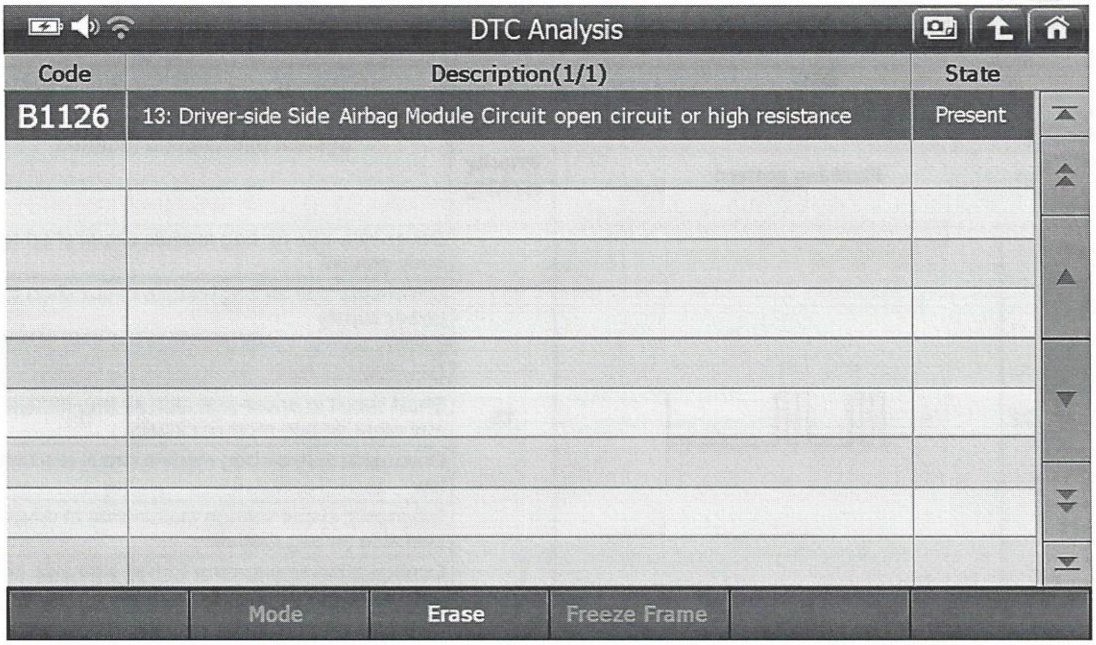
CASE STUDY #2 - MAZDA continued...

Basic Inspection:

- A visual check of the visible SRS components appeared normal.
- The battery and charging system were operating normally.
- A DTC check found code B1126

CASE STUDY #2 - MAZDA continued...

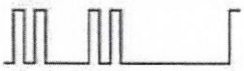
Basic Inspection:


DTC Analysis
Mode
Erase
Freeze Frame

Code	Description(1/1)	State
B1126	13: Driver-side Side Airbag Module Circuit open circuit or high resistance	Present

CASE STUDY #2 - MAZDA continued...

Detailed Inspection:

DTC				System malfunction location
Mazda Modular Diagnostic System (M-MDS) menu	Air bag system warning light			
		Flashing pattern	Priority ranking	
B1126:11	22		15	Driver-side side air bag module circuit short to body ground
B1126:12				Driver-side side air bag module circuit short to power supply
B1126:13				Driver-side side air bag module circuit open circuit or resistance high
B1126:19				Short circuit to driver-side side air bag module and other air bag module circuits
B1126:1A				Driver-side side air bag module circuit resistance low
B1126:1C				Diagnostic circuit voltage malfunction in driver-side side air bag module
B1126:55				Configuration setting error (driver-side side air bag module structural malfunction)

CASE STUDY #2 - MAZDA continued...

Detailed Inspection:

Test #1:

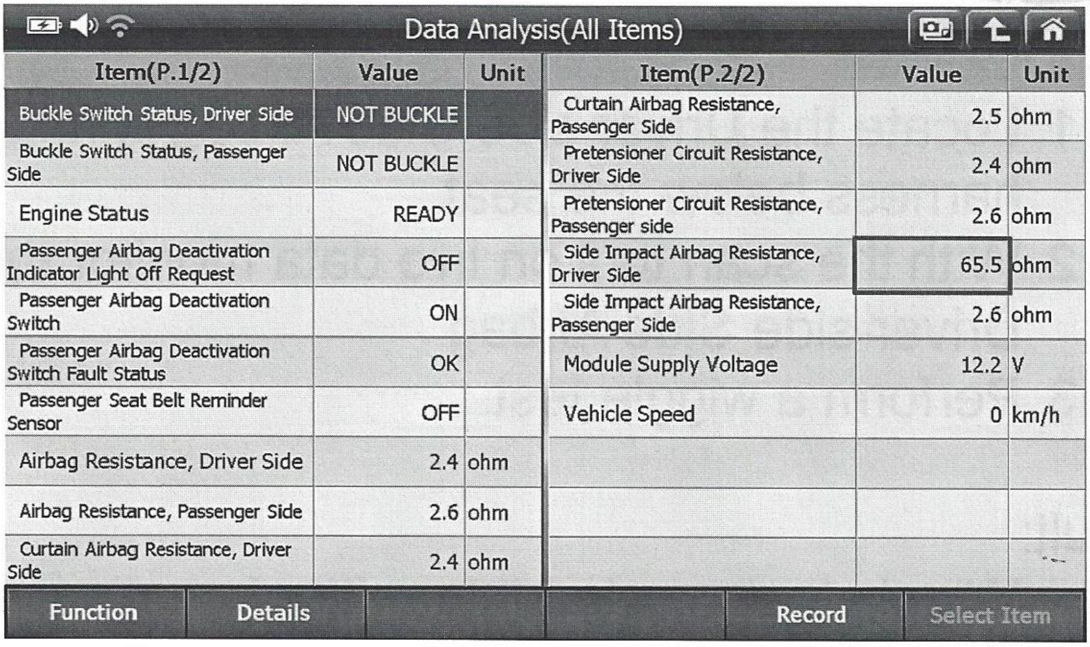
1. Locate the Driver-side Side Airbag wiring harness below the seat
2. With the scan tool on live data monitor the Driver-side Side Airbag
3. Perform a wiggle test.

Result:

Wiggle test created intermittent continuity.

CASE STUDY #2 - MAZDA continued...

Detailed Inspection:



Data Analysis(All Items)

Item(P.1/2)	Value	Unit	Item(P.2/2)	Value	Unit
Buckle Switch Status, Driver Side	NOT BUCKLE		Curtain Airbag Resistance, Passenger Side	2.5	ohm
Buckle Switch Status, Passenger Side	NOT BUCKLE		Pretensioner Circuit Resistance, Driver Side	2.4	ohm
Engine Status	READY		Pretensioner Circuit Resistance, Passenger side	2.6	ohm
Passenger Airbag Deactivation Indicator Light Off Request	OFF		Side Impact Airbag Resistance, Driver Side	65.5	ohm
Passenger Airbag Deactivation Switch	ON		Side Impact Airbag Resistance, Passenger Side	2.6	ohm
Passenger Airbag Deactivation Switch Fault Status	OK		Module Supply Voltage	12.2	V
Passenger Seat Belt Reminder Sensor	OFF		Vehicle Speed	0	km/h
Airbag Resistance, Driver Side	2.4	ohm			
Airbag Resistance, Passenger Side	2.6	ohm			
Curtain Airbag Resistance, Driver Side	2.4	ohm			

STANDARD RESISTANCE 1.5 Ω – 3 Ω

CASE STUDY #2 - MAZDA continued...

Detailed Inspection:

Test #2:

1. Disconnect the battery and wait 1 Minute
2. Disconnect the Driver-side Side Airbag
3. Insert a 2.4Ω simulator
4. Connect battery and repeat Test #1

Result:

Wiggle test caused no interruption to the continuity.

CASE STUDY #2 - MAZDA continued...

Detailed Inspection:

Diagnosis:

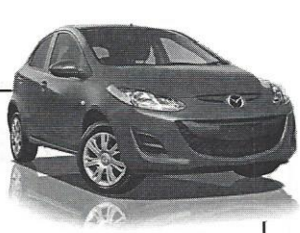
- Fault exists in the Driver-side Side Airbag "fly-lead".
- Mazda forbid wiring repairs on any part of the SRS, so no further diagnosis is required

Fix:

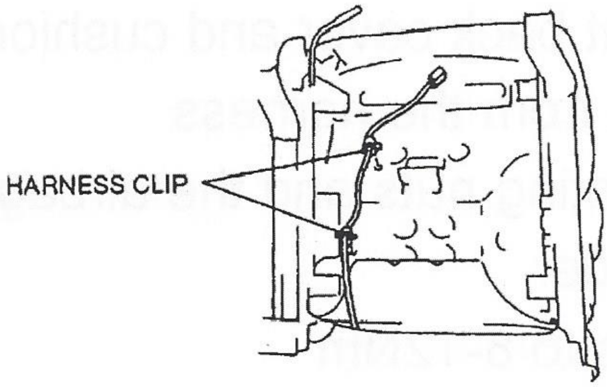
- Replace the Driver-side Side Airbag

Fly-lead: *A section of wiring harness that is part of a component (not serviced separately)!*

CASE STUDY #2 - MAZDA continued...



Detailed Inspection:



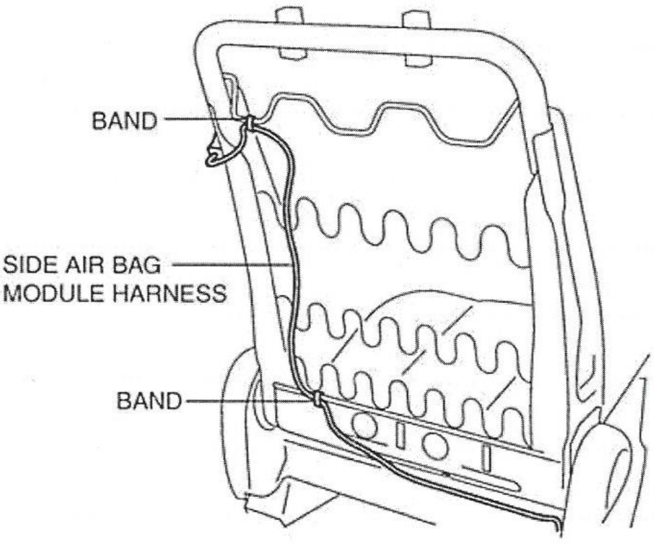
Air Bag Wiring Harness Repair

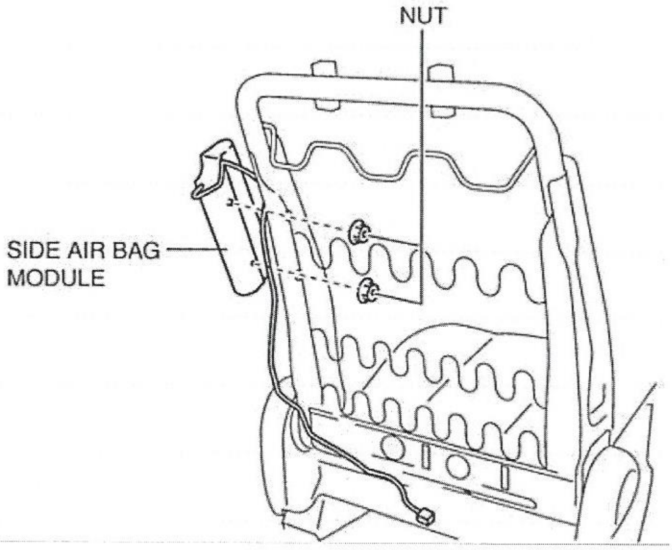
- **Incorrectly repairing an air bag wiring harness can accidentally operate (deploy) the air bag module and pre-tensioner seat belts. If a problem is found in the air bag wiring harness, always replace the wiring harness with a new one.**

CASE STUDY #2 - MAZDA continued...

Perform Repair:

- Remove the seat, seat back cover and cushion
- Cut the two cable ties from the harness
- Remove the two mounting nuts and the airbag
- Replace in reverse order
- Tighten mounting nuts to 8-12Nm
- Secure harness with new cable ties


BAND
SIDE AIR BAG MODULE HARNESS
BAND


NUT
SIDE AIR BAG MODULE

CASE STUDY #2 - MAZDA continued...

Verify Repair:

- Erase DTC's
- Perform wiggle test
- Re-check DTC's

CASE STUDY #2 - MAZDA continued...

Finalise Repair:

Before this job can be finished the faulty pre-tensioner must be deployed before it can be disposed of.

CASE STUDY #3 - FORD

Vehicle:	2011 Ford G6 MkII 4.0L I6
Complaint:	Vehicle has not been involved in a collision recently. Long term history unknown. SRS Lamp is ON and flashes intermittently.
Condition:	SRS Lamp flashes for a short while and then remains ON.

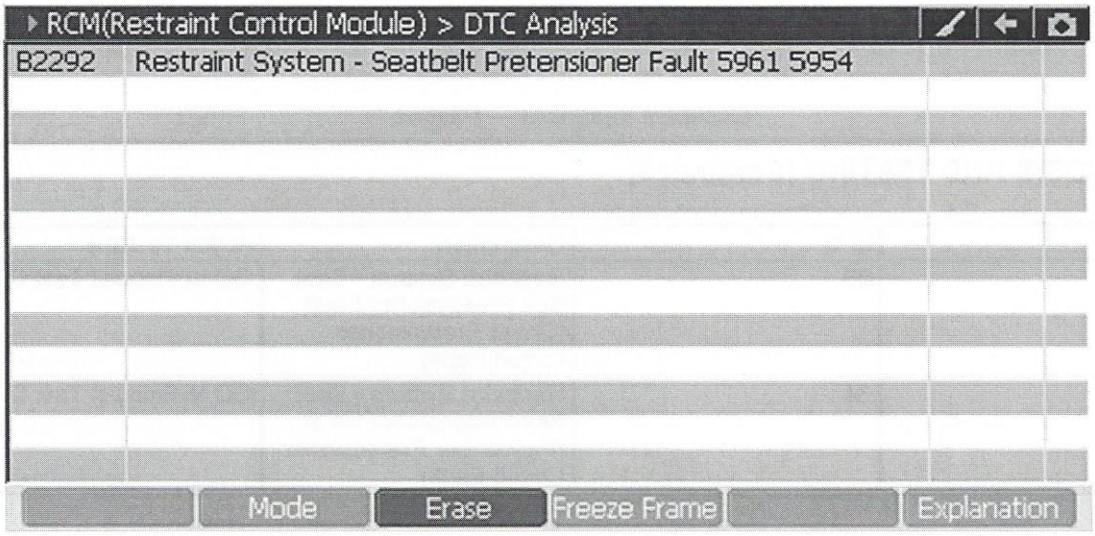
CASE STUDY #3 - FORD continued...

Basic Inspection:

- A visual check of the visible SRS components appeared normal.
- The battery and charging system were operating normally.
- The report of no collision damaged, appears visually accurate.
- A DTC check reports the logging of a B2292 code.

CASE STUDY #3 - FORD continued...

Basic Inspection:



RCM(Restraint Control Module) > DTC Analysis

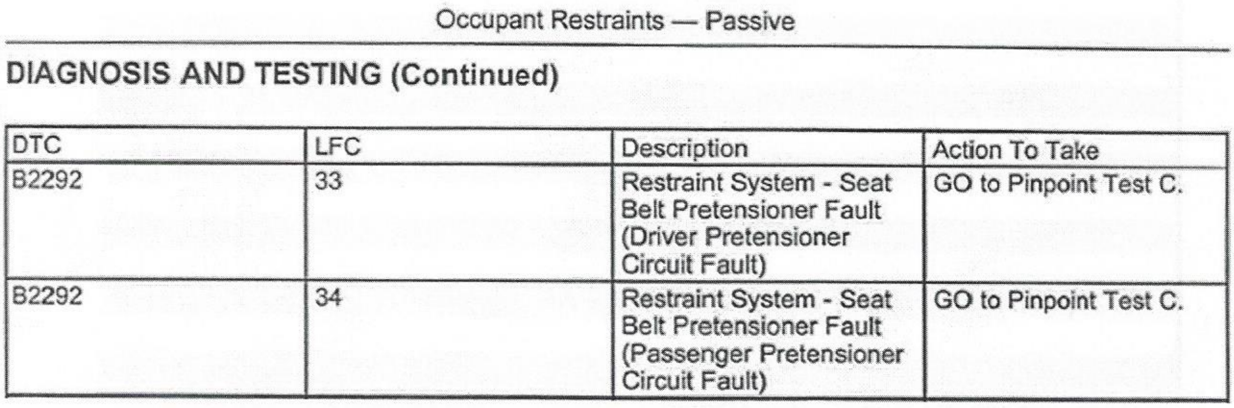
B2292	Restraint System - Seatbelt Pretensioner Fault 5961 5954

Mode
Erase
Freeze Frame
Explanation

CASE STUDY #3 - FORD continued...

Detailed Inspection:

DTC details



Occupant Restraints — Passive

DIAGNOSIS AND TESTING (Continued)

DTC	LFC	Description	Action To Take
B2292	33	Restraint System - Seat Belt Pretensioner Fault (Driver Pretensioner Circuit Fault)	GO to Pinpoint Test C.
B2292	34	Restraint System - Seat Belt Pretensioner Fault (Passenger Pretensioner Circuit Fault)	GO to Pinpoint Test C.

CASE STUDY #3 - FORD continued...

Detailed Inspection:

Diagnostic test

- Option #1 – Scan tool
- Option #2 – Flash codes

Flash codes are output via the SRS Lamp.

To read the SRS Flash Codes:

1. Turn the ignition ON
2. The SRS Lamp will illuminate for 6 seconds
3. The lamp will then display the 2 digit code/s
4. The last code will be repeated 3 times

CASE STUDY #3 - FORD continued...

Detailed Inspection:

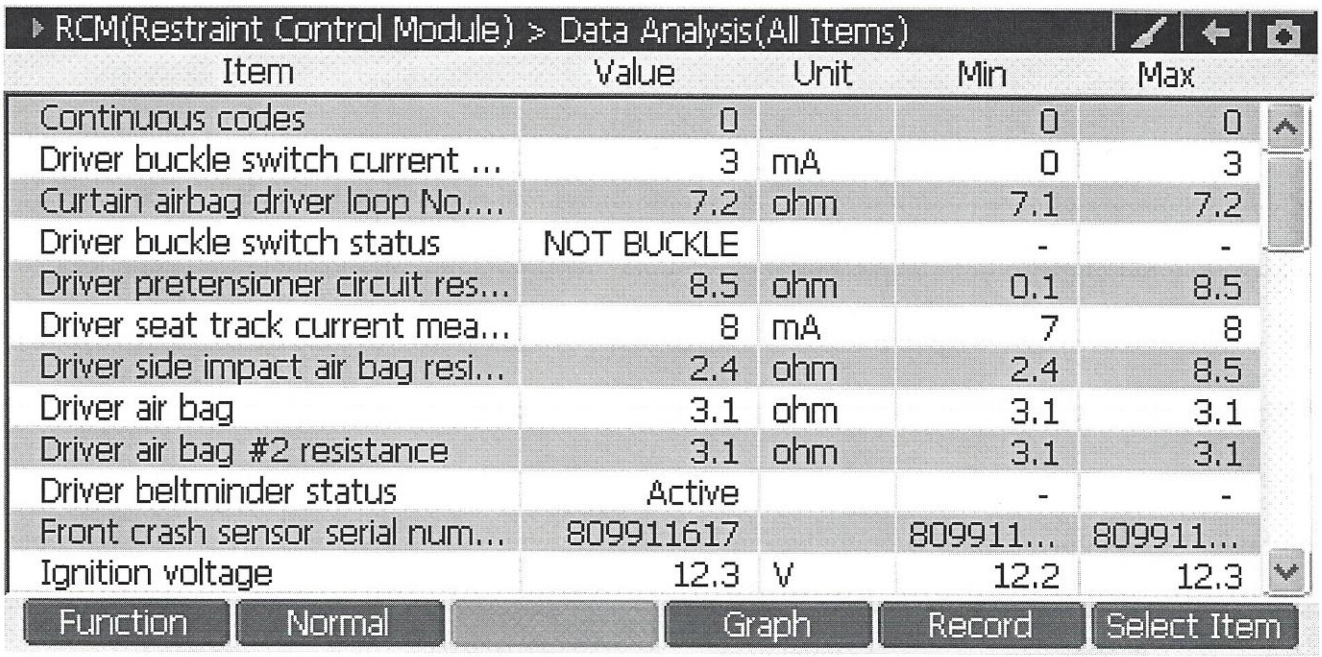
Scan Tool

Use live data to determine which pretensioner circuit is at fault.

- Driver = 8.5Ω
- Passenger = 2.3Ω

Flash Codes

- LFC 33 = Driver
- LFC 34 = Passenger



▸ RCM(Restraint Control Module) > Data Analysis(All Items)
Function
Normal
Graph
Record
Select Item

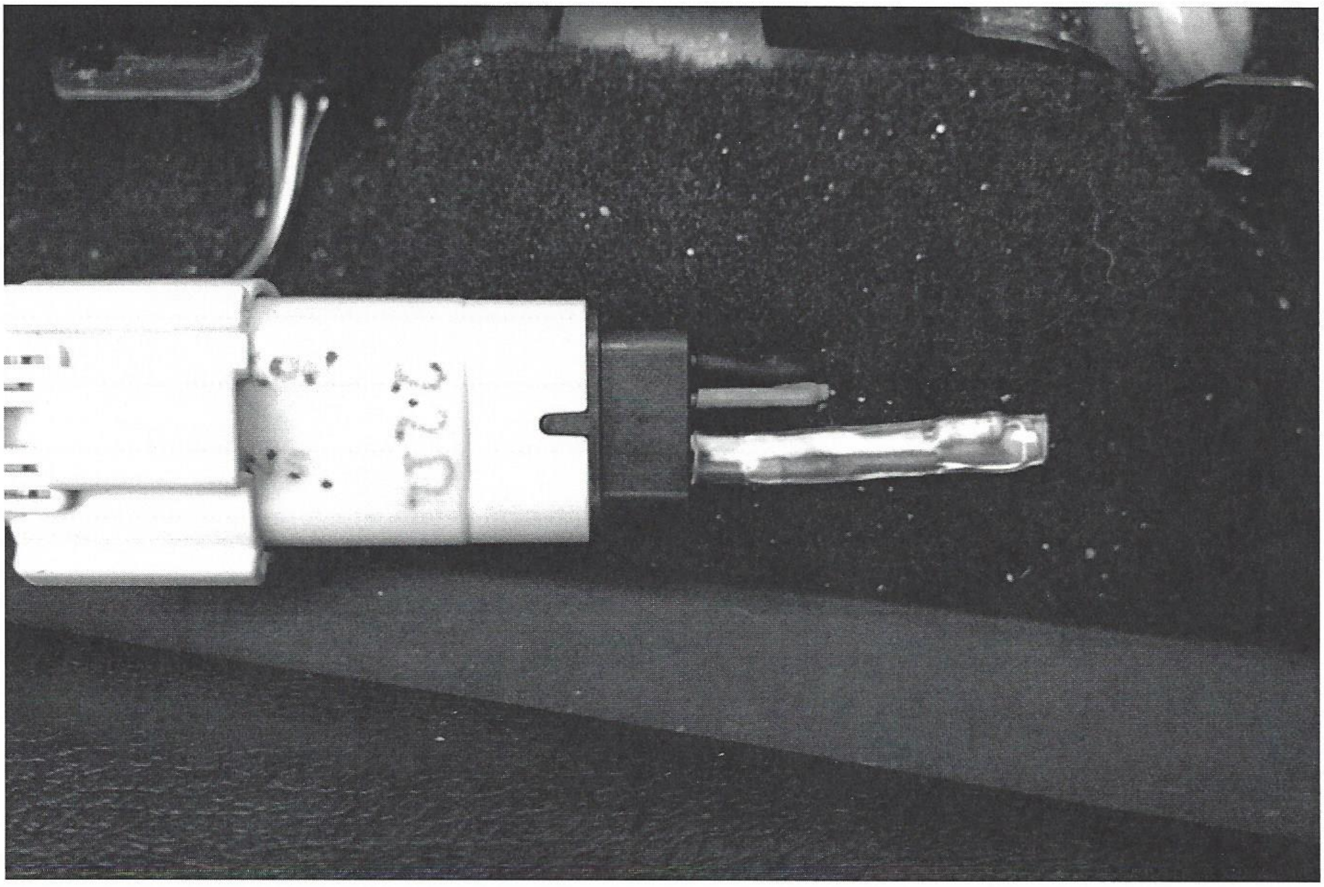
Item	Value	Unit	Min	Max
Continuous codes	0		0	0
Driver buckle switch current ...	3	mA	0	3
Curtain airbag driver loop No....	7.2	ohm	7.1	7.2
Driver buckle switch status	NOT BUCKLE		-	-
Driver pretensioner circuit res...	8.5	ohm	0.1	8.5
Driver seat track current mea...	8	mA	7	8
Driver side impact air bag resi...	2.4	ohm	2.4	8.5
Driver air bag	3.1	ohm	3.1	3.1
Driver air bag #2 resistance	3.1	ohm	3.1	3.1
Driver beltminder status	Active		-	-
Front crash sensor serial num...	809911617		809911...	809911...
Ignition voltage	12.3	V	12.2	12.3

The normal expected resistance range is 1.50 to 3.04 ohms.

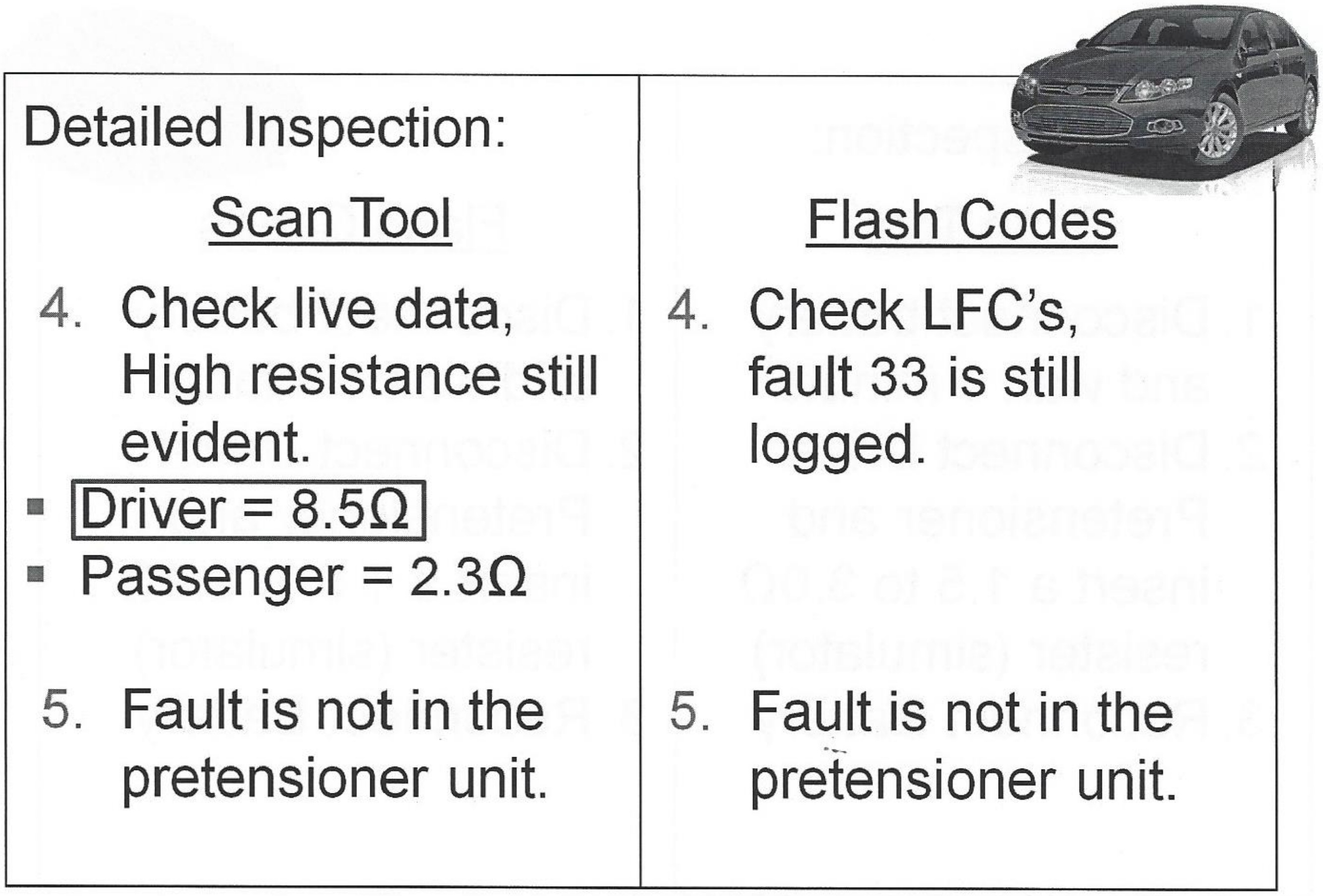
CASE STUDY #3 - FORD continued...

Detailed Inspection:

Scan Tool	Flash Codes
1. Disconnect battery and wait 1 minute	1. Disconnect battery and wait 1 minute
2. Disconnect Driver Pretensioner and insert a 1.5 to 3.0Ω resister (simulator)	2. Disconnect Driver Pretensioner and insert a 1.5 to 3.0Ω resister (simulator)
3. Reconnect Battery	3. Reconnect Battery



CASE STUDY #3 - FORD continued...



Detailed Inspection:

Scan Tool	Flash Codes
4. Check live data, High resistance still evident.	4. Check LFC's, fault 33 is still logged.
▪ Driver = 8.5Ω ▪ Passenger = 2.3Ω	
5. Fault is not in the pretensioner unit.	5. Fault is not in the pretensioner unit.

CASE STUDY #3 - FORD continued...

Detailed Inspection:

Scan Tool	Flash Codes
6. Monitor the live data while performing a wiggle test. No change	6. Disconnect battery and wait 1 minute
7. Remove centre console	7. Remove centre console

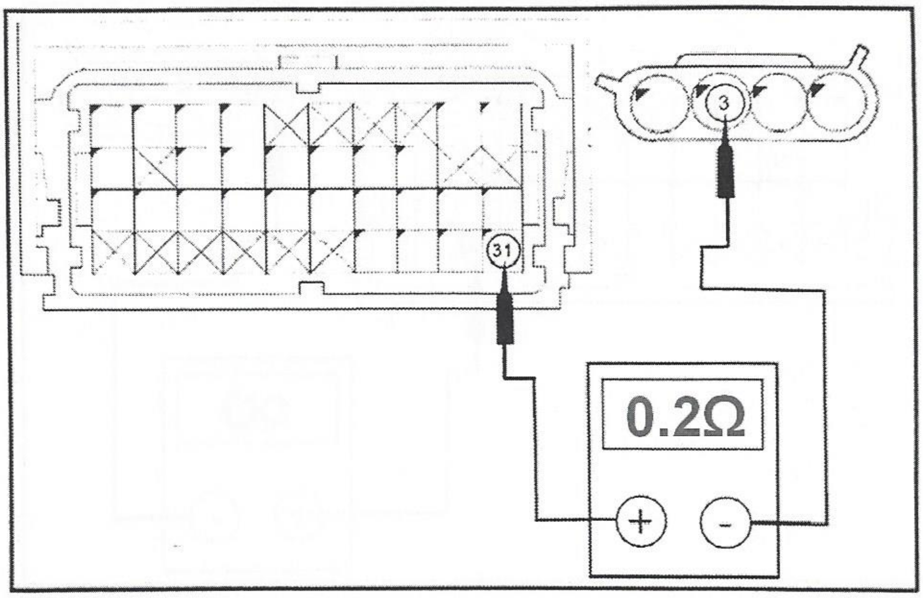
CASE STUDY #3 - FORD continued...

Detailed Inspection:

Scan Tool	Flash Codes
8. Use a suitable Ohmmeter to test the continuity of both pretensioner wires	8. Use a suitable Ohmmeter to test the continuity of both pretensioner wires

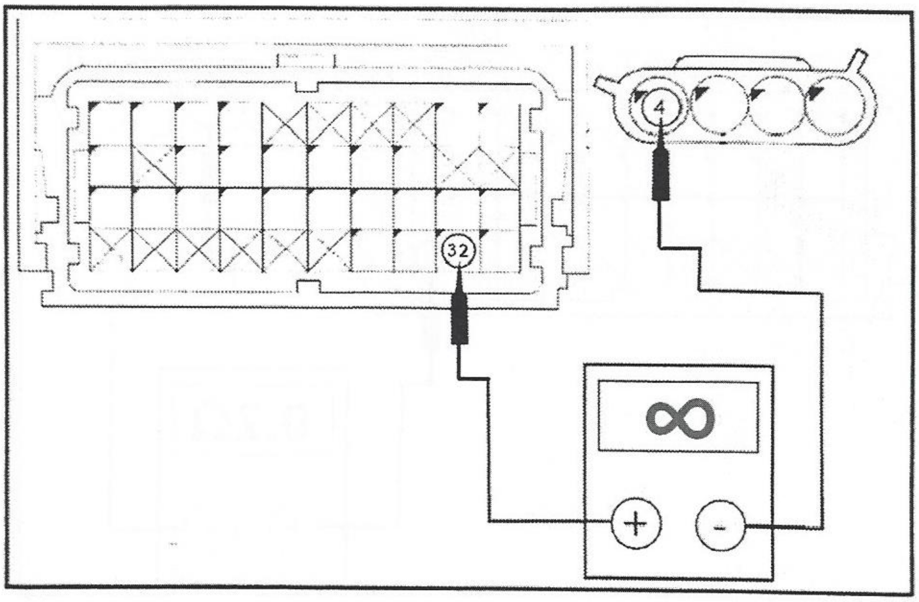
CASE STUDY #3 - FORD continued...

Detailed Inspection:



CASE STUDY #3 - FORD continued...

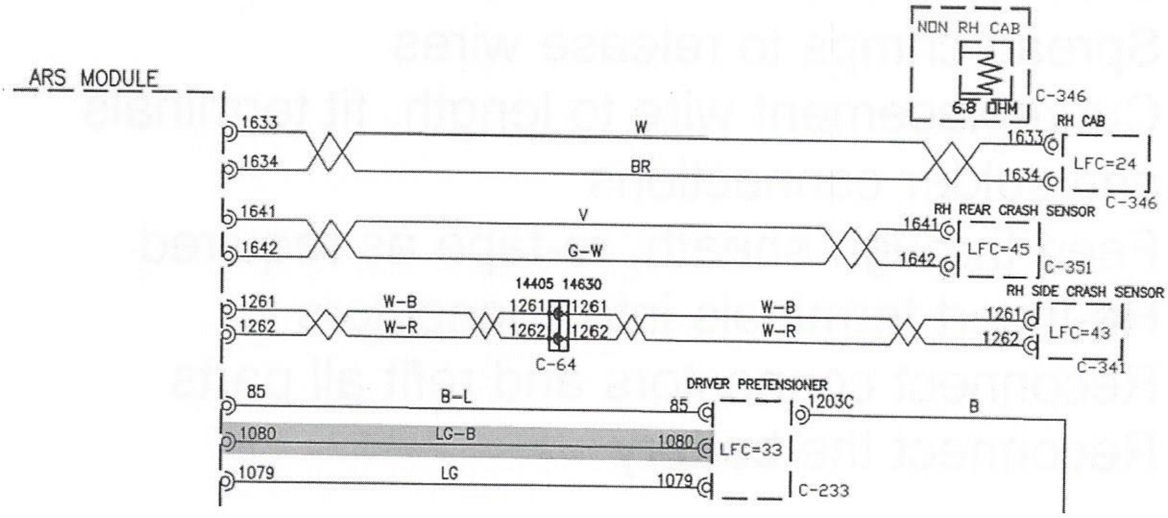
Detailed Inspection:



CASE STUDY #3 - FORD continued...

Diagnosis:

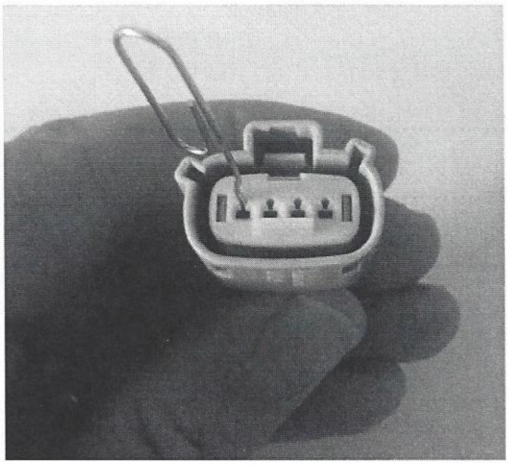
- Open circuit in the 1080 (LG-B) wire

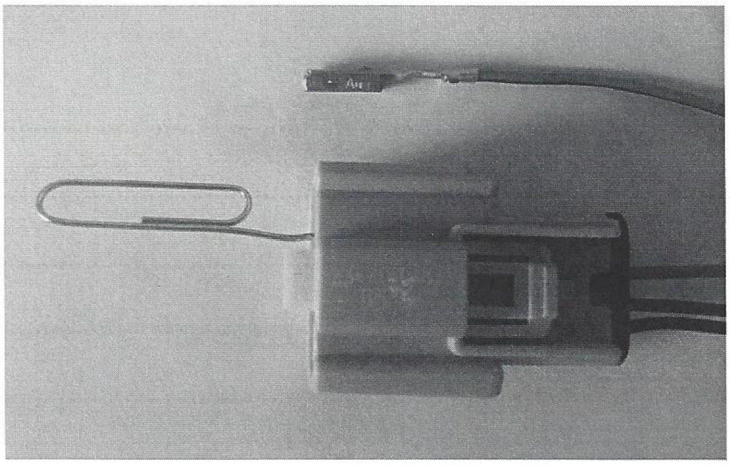

ARS MODULE
NON RH CAB
6.8 OHM
C-346
RH CAB
LFC=24
C-346
1633
1634
W
BR
1641
1642
V
G-W
RH REAR CRASH SENSOR
LFC=45
C-351
14405 14630
1261
1262
W-B
W-R
C-64
RH SIDE CRASH SENSOR
LFC=43
C-341
85
B-L
1080
LG-B
1079
LG
DRIVER PRETENSIONER
1203C
B
LFC=33
C-233

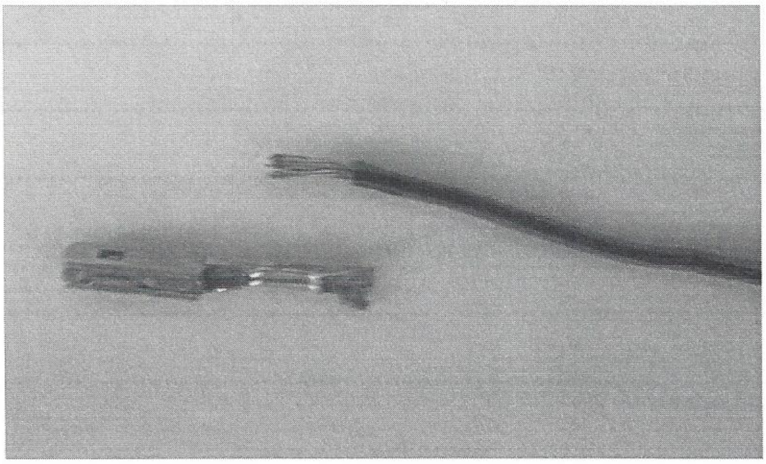
CASE STUDY #3 - FORD continued...

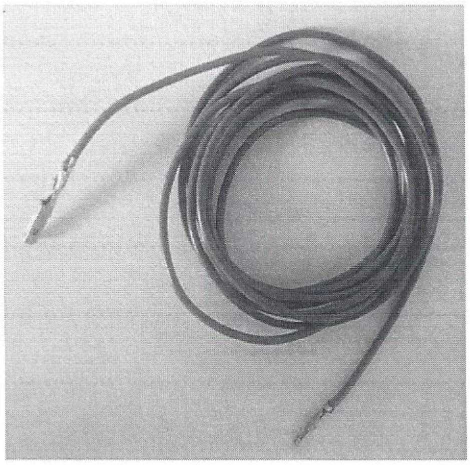
Perform Repair:

1. Back terminals out control module pin #34 & drivers pretensioner harness connector #4
2. Spread crimps to release wires
3. Cut replacement wire to length, fit terminals and solder connections
4. Feed through sheath, re-tape as required
5. Re-insert terminals into connectors
6. Reconnect connectors and refit all parts
7. Reconnect the battery









CASE STUDY #3 - FORD continued...

Verify Repair:

- Turn the ignition ON
- Check DTC's and erase if necessary
- Check that the Airbag light illuminates for 6 seconds and then extinguishes
- If you have a scan tool, checking the drivers pretensioner circuit resistance in live data is advisable.

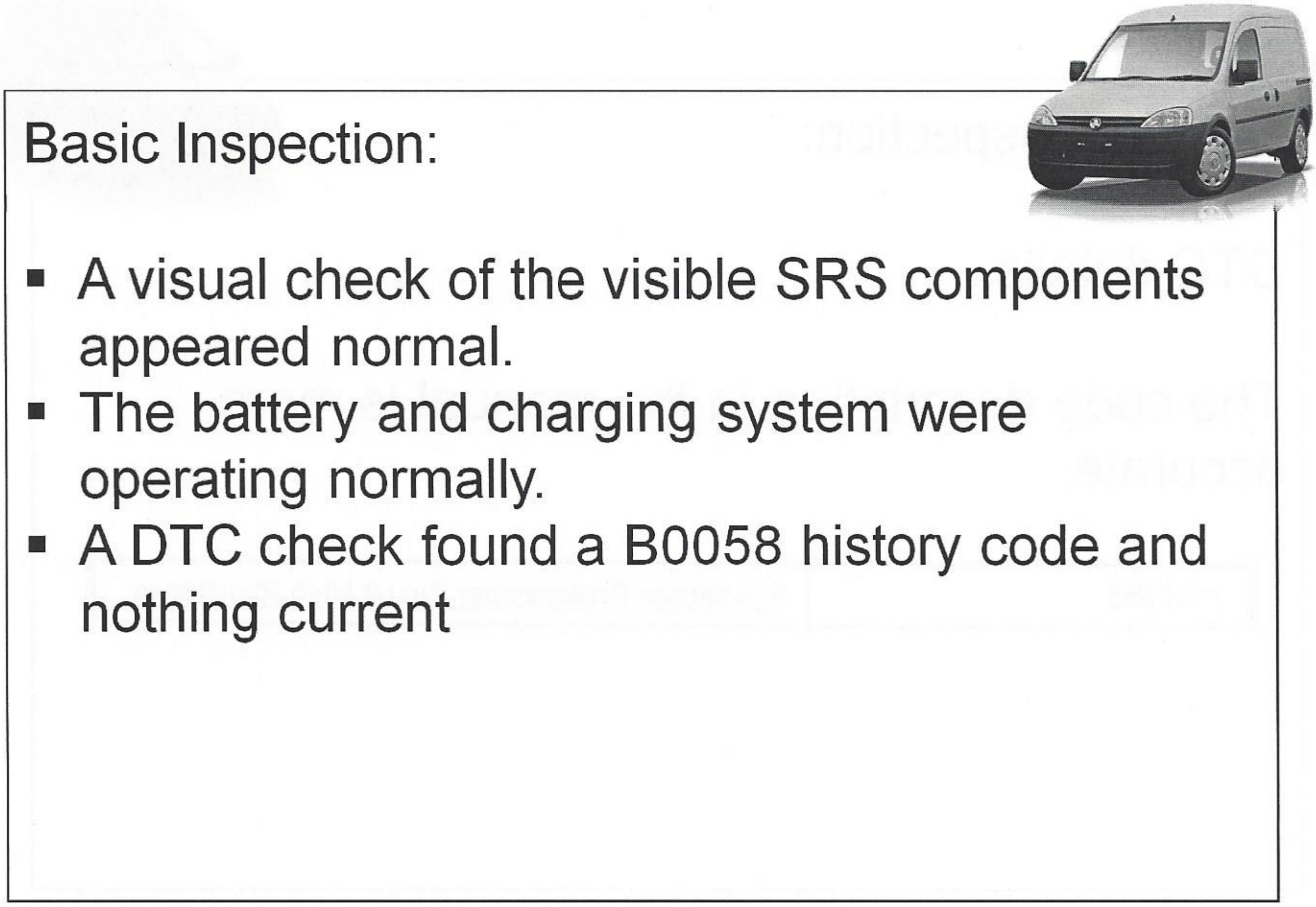
CASE STUDY #4 - HOLDEN

Vehicle: 2009 Holden Combo Series II 1.4L I4

Complaint 1: Vehicle has never been involved in an accident, SRS light is intermittently ON while driving.

Condition: SRS Lamp was operating normally when it was received at the workshop.

CASE STUDY #4 - HOLDEN continued...



Basic Inspection:

- A visual check of the visible SRS components appeared normal.
- The battery and charging system were operating normally.
- A DTC check found a B0058 history code and nothing current

CASE STUDY #4 - HOLDEN continued...

Detailed Inspection:

DTC details

The code description in the manual is more accurate.

☐ B0058	Passenger Pretensioner Circuit High Resistance

CASE STUDY #4 - HOLDEN continued...

Detailed Inspection:

Intermittent Fault, attempt to recreate fault condition.

- Visually inspect the pretensioner
- Connect scan to a view live data
- Find connector below the seat and perform a wiggle test.

All tests were unsuccessful, the customer returned to collect the vehicle.

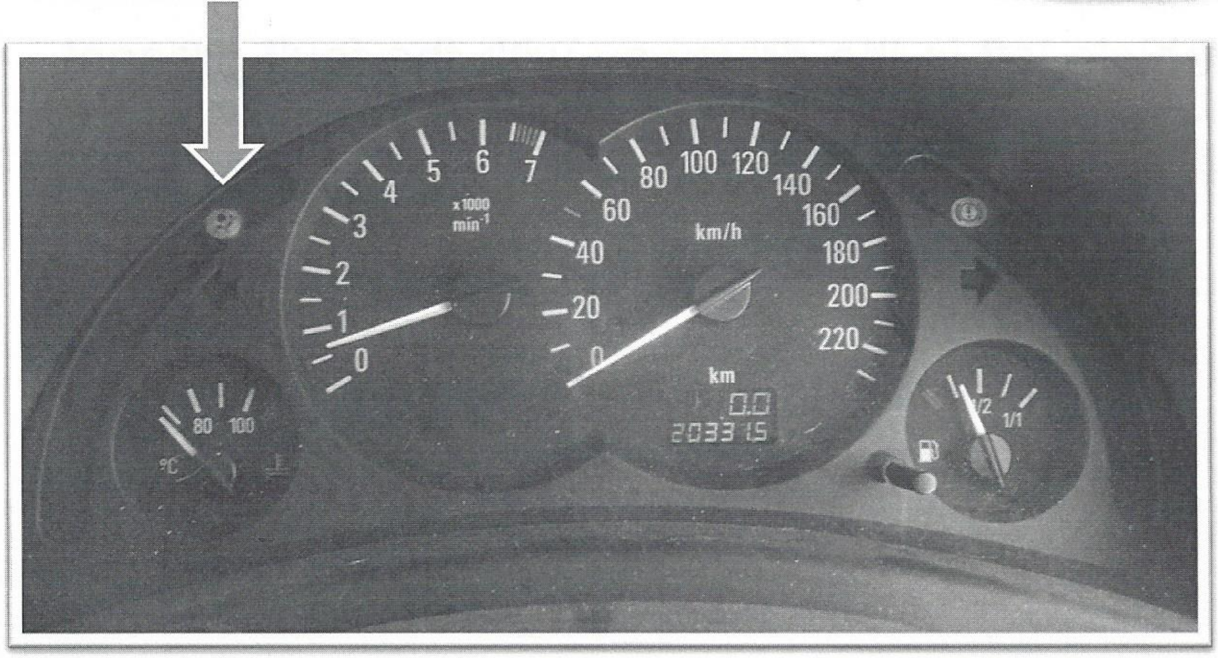
CASE STUDY #4 - HOLDEN continued...

Customer enters the vehicle and begins to drive away...

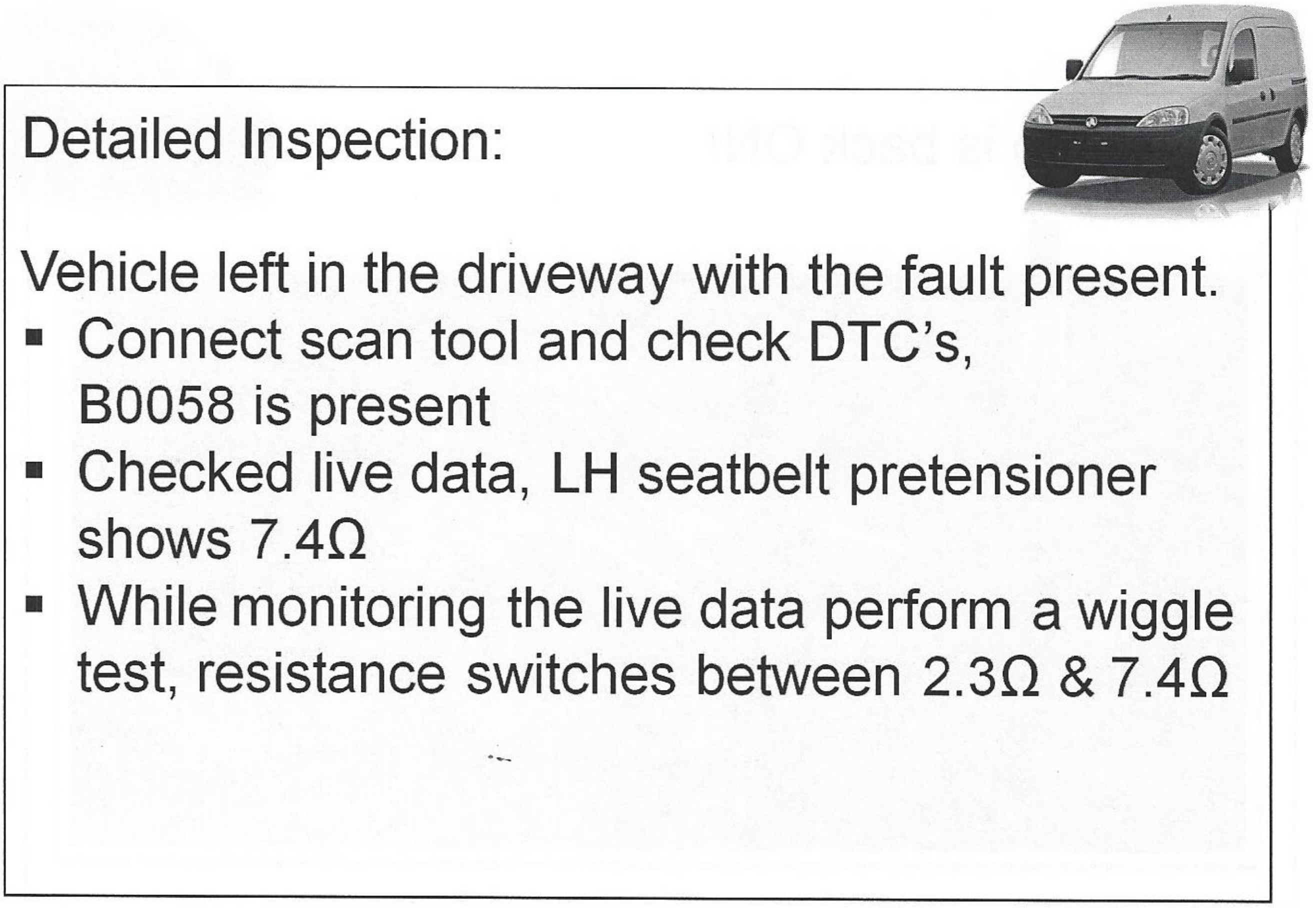
...and then stops!

CASE STUDY #4 - HOLDEN continued...

SRS Lamp is back ON!


x1000
min-1
km/h
km
0.0
203315
°C
80
100
1/2
1/1

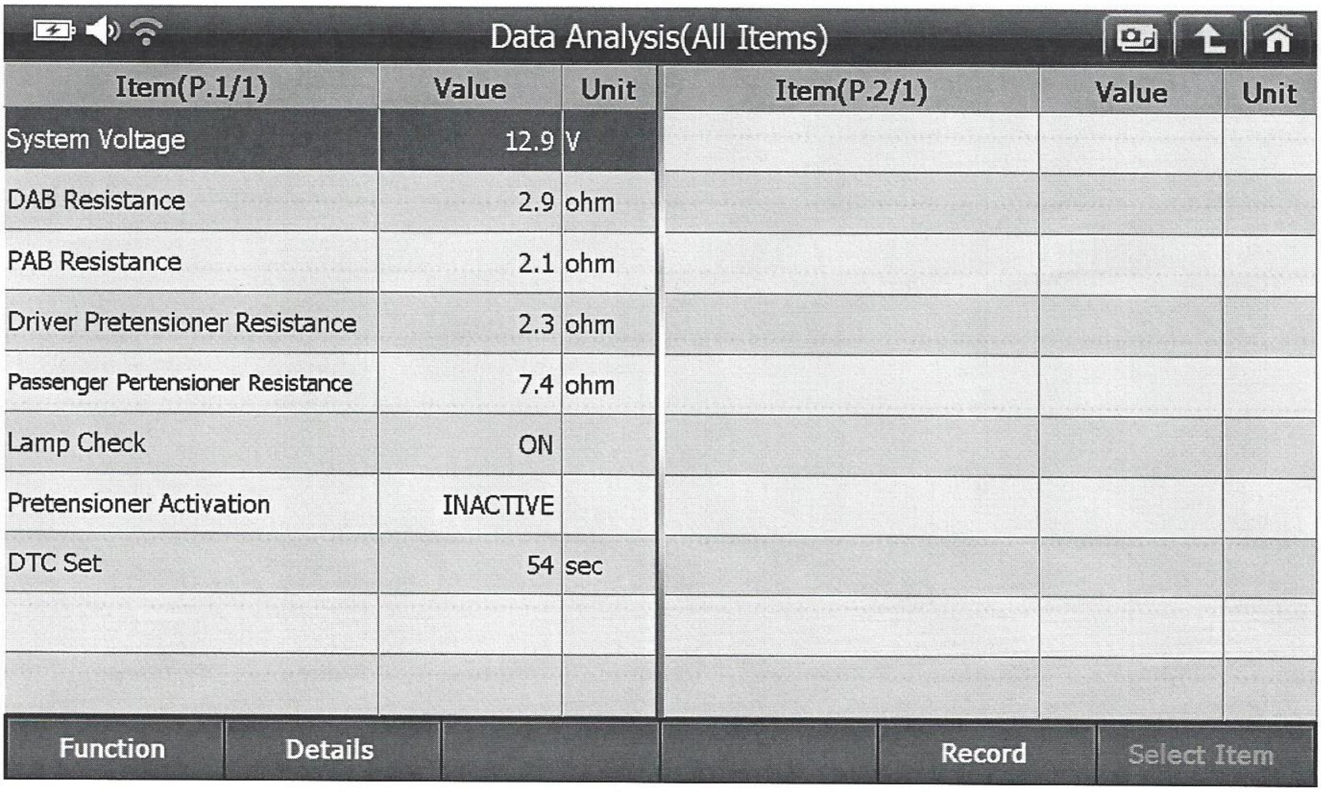
CASE STUDY #4 - HOLDEN continued...



Detailed Inspection:

Vehicle left in the driveway with the fault present.

- Connect scan tool and check DTC's, B0058 is present
- Checked live data, LH seatbelt pretensioner shows 7.4Ω
- While monitoring the live data perform a wiggle test, resistance switches between 2.3Ω & 7.4Ω



Data Analysis(All Items)

Item(P.1/1)	Value	Unit
System Voltage	12.9	V
DAB Resistance	2.9	ohm
PAB Resistance	2.1	ohm
Driver Pretensioner Resistance	2.3	ohm
Passenger Pertensioner Resistance	7.4	ohm
Lamp Check	ON	
Pretensioner Activation	INACTIVE	
DTC Set	54	sec

Item(P.2/1)	Value	Unit

CASE STUDY #4 - HOLDEN continued...

Detailed Inspection:

It is unsafe to test any pyrotechnic component.

As the damaged wiring is part of the “fly-lead” no further testing can be carried out.

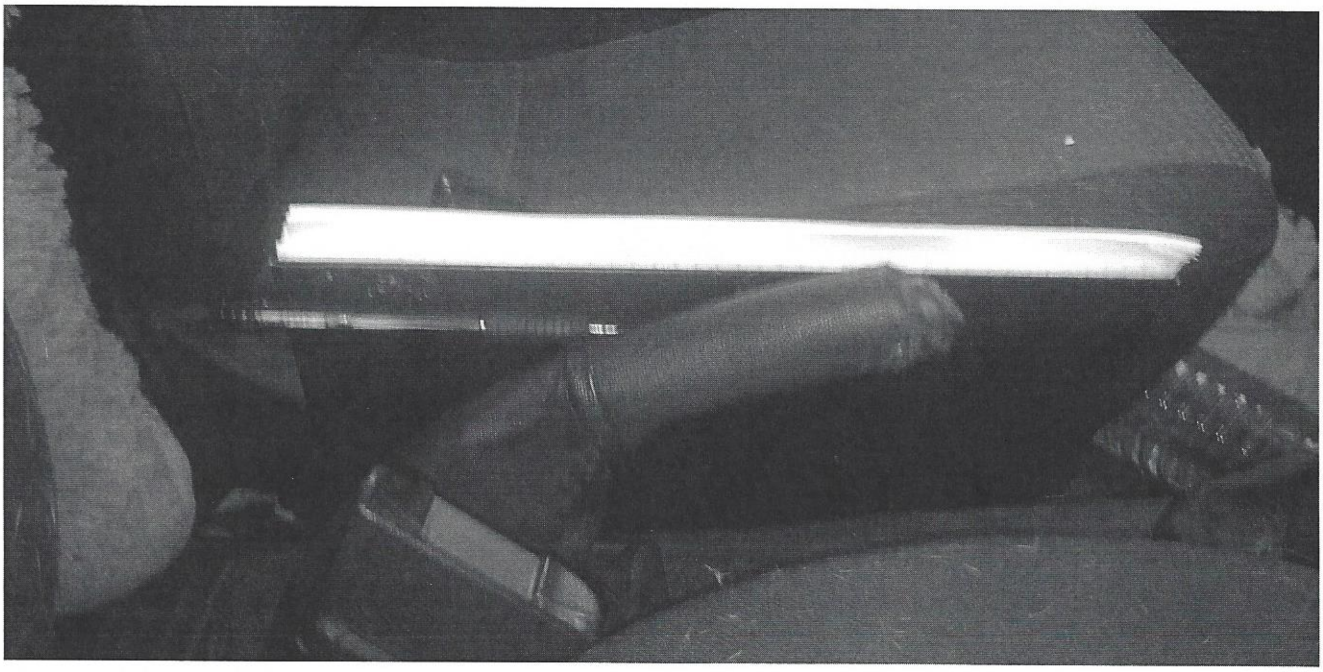
Fly-lead: A section of wiring harness that is part of a component (not serviced separately).

CASE STUDY #4 - HOLDEN continued...

Detailed Inspection:

After years of placing a yearly planner / diary in the gap between the console and seat have stressed the LH pretensioner lead to breaking point.

Caution: Holden does NOT permit wiring repairs to the SRS for the Combo.
A complete seat belt stalk and pretensioner will be required.



CASE STUDY #4 - HOLDEN continued...

Perform Repair:

Replace LH Seatbelt pretensioner:

1. Disconnect the Battery and wait for 60 seconds
2. Unplug the pretensioner harness connector
3. Remove the passenger seat
4. Undo the single Torx retaining bolt
5. Check that the new part matches the old
6. Fit the new pretensioner in the reverse order

CASE STUDY #4 - HOLDEN continued...

Verify Repair:

- Erase DTC's
- Perform wiggle test
- Re-check DTC's
- Explain to customer that a new location for the diary is required!

CASE STUDY #4 - HOLDEN continued...

Finalise Repair:

Before this job can be finished the faulty pre-tensioner must be deployed before it can be disposed of.

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CASE STUDY #5 - HYUNDAI

Vehicle: 2013 Hyundai Accent
1.4L I4

Complaint 1: SRS Lamp is intermittently ON.

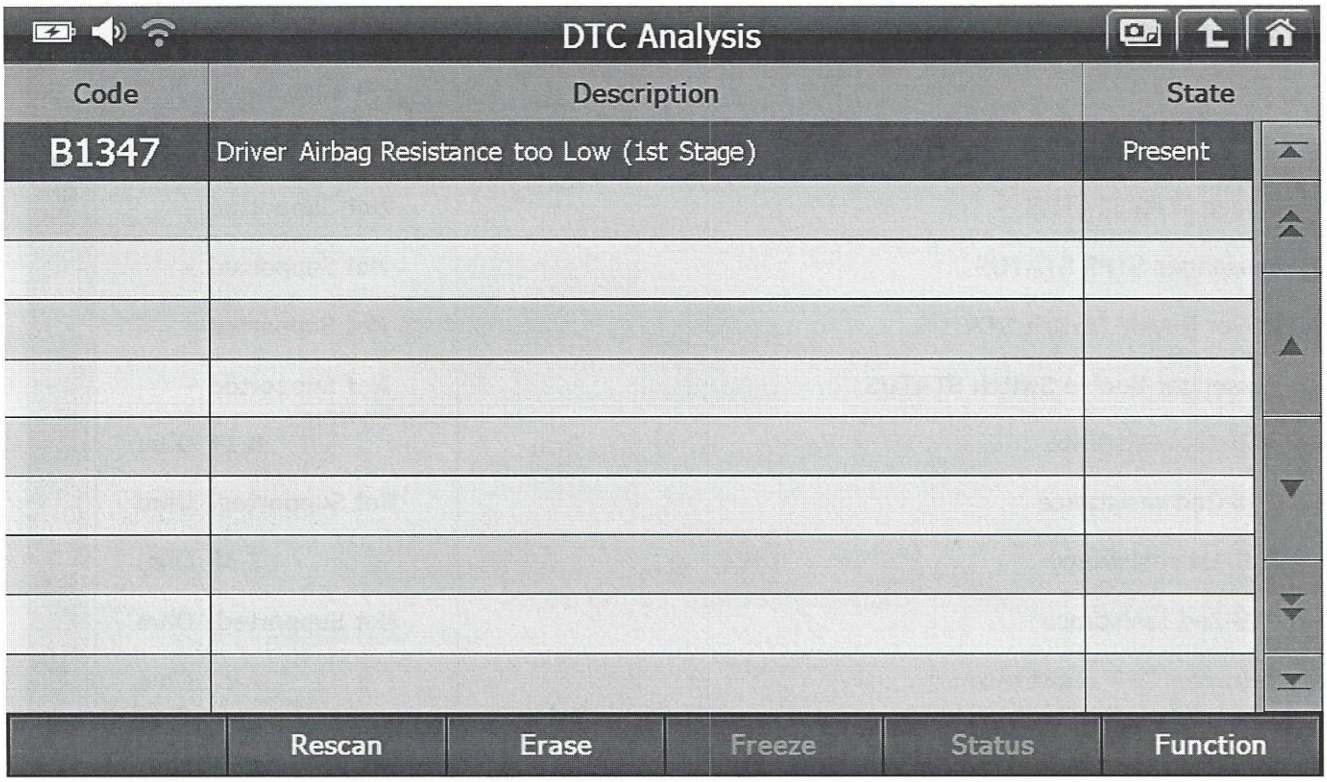
Background: Vehicle has involved in a major accident, New front airbags, SRS Control module and pretensioners fitted by interstate crash repairer.

Condition: SRS Lamp is currently ON.

CASE STUDY #5 - HYUNDAI continued...

Basic Inspection:

- A visual check of the visible SRS components appeared normal.
- The battery and charging system were operating normally.
- A DTC check found code B1347



DTC Analysis

Code	Description	State
B1347	Driver Airbag Resistance too Low (1st Stage)	Present

Rescan
Erase
Freeze
Status
Function

CASE STUDY #5 - HYUNDAI continued...

Detailed Inspection:

DTC details

ACCENT(RB) >2013 > G 1.6 GDI > Airbag > All Systems > B1347 Driver Airbag Resistance too Low (1st stage) > DTC Information

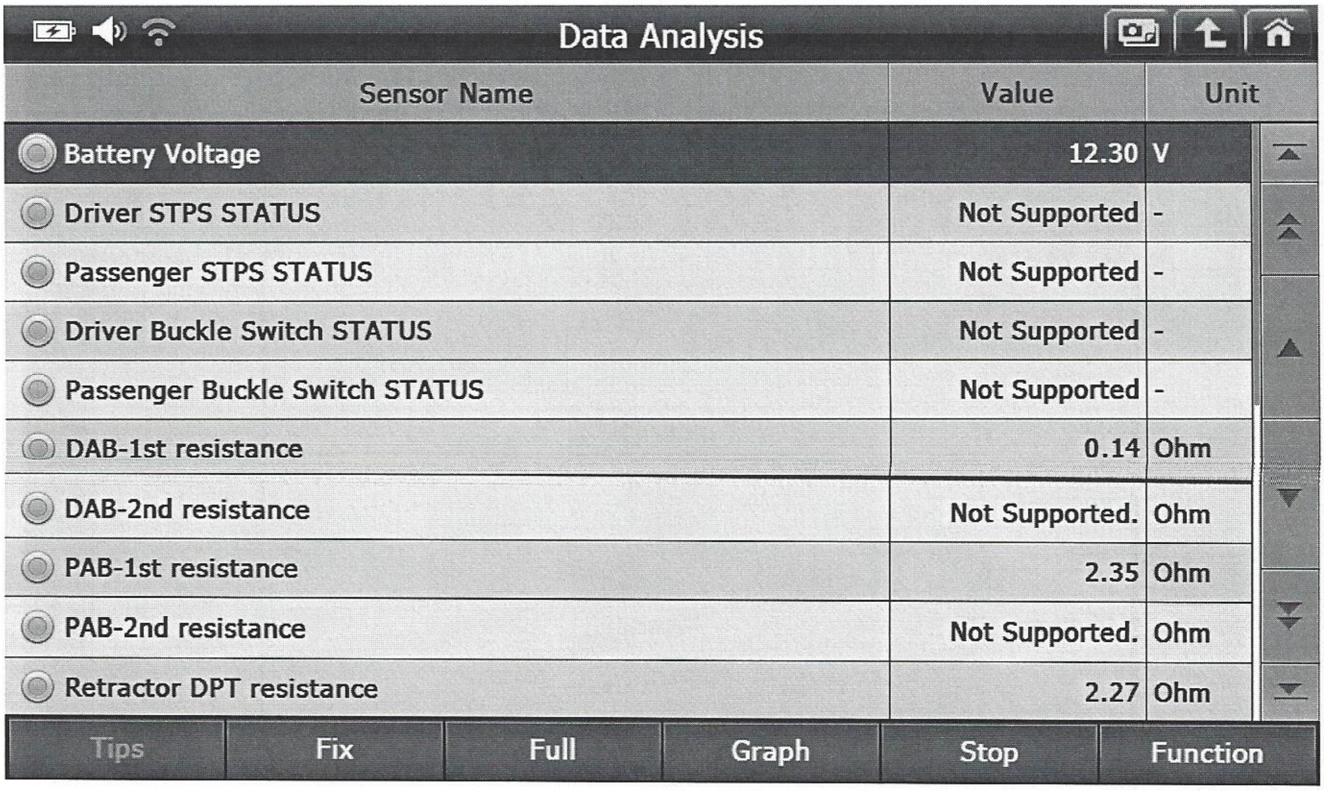
DTC Description

The SRSCM sets DTC B1347 if the measured resistance value of DAB circuit is less than the threshold value (1.5Ω)

*In this case, SRSCM checks if there's any fault in circuit by sending current for a while.

DTC Detecting Condition

Item		Detecting Condition	Possible cause
DTC Strategy		• Check Resistance	1. Poor connection of connected part. 2. Poor connection between shorting bar and release pin. 3. Faulty DAB. 4. Faulty Clock spring. 5. Check SRSCM.
Enable Conditions		• Ignition "ON"	
Threshold Value		• DAB 1st stage Squib resistance is less than 1.5Ω	
Diagnostic Time	Qualification	• More than 1 sec (100ms x 10)	
	De-Qualification	• More than 2 sec (100ms x 20)	



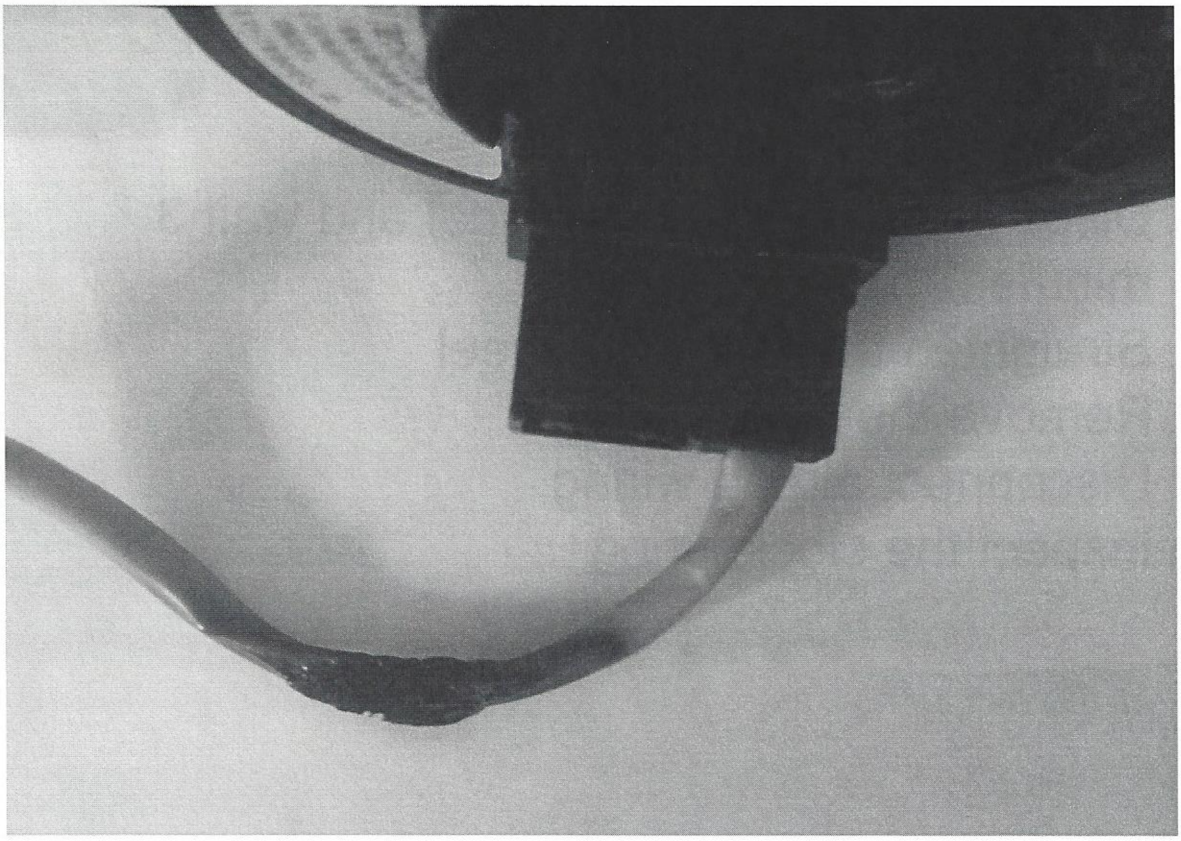
Sensor Name	Value	Unit
Battery Voltage	12.30	V
Driver STPS STATUS	Not Supported	-
Passenger STPS STATUS	Not Supported	-
Driver Buckle Switch STATUS	Not Supported	-
Passenger Buckle Switch STATUS	Not Supported	-
DAB-1st resistance	0.14	Ohm
DAB-2nd resistance	Not Supported.	Ohm
PAB-1st resistance	2.35	Ohm
PAB-2nd resistance	Not Supported.	Ohm
Retractor DPT resistance	2.27	Ohm

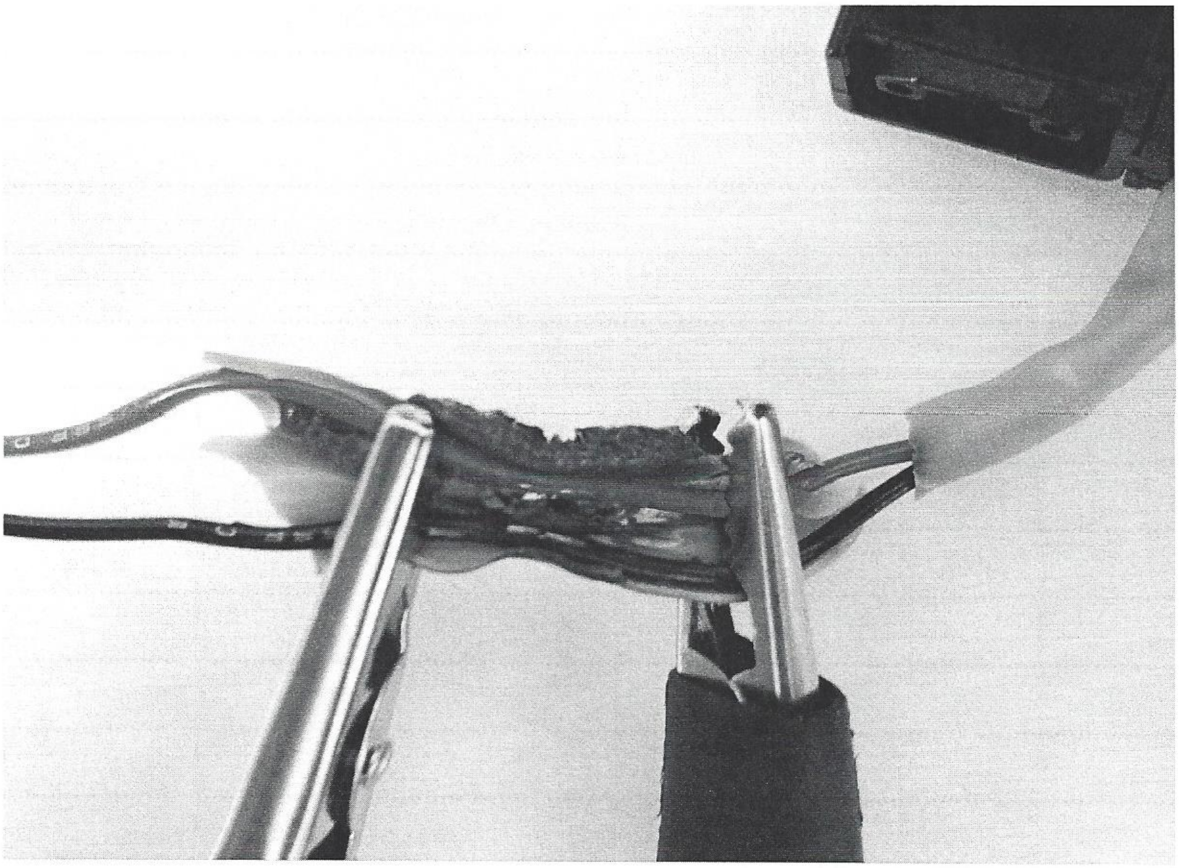
CASE STUDY #5 - HYUNDAI continued...

Detailed Inspection:

1. Disconnect '-' battery terminal and wait 3 minutes
2. Straighten the steering wheel
3. Remove the 2 airbag bolts
4. Disconnect airbag wiring
5. Inspect the clockspring

CASE STUDY #5 - HYUNDAI continued...





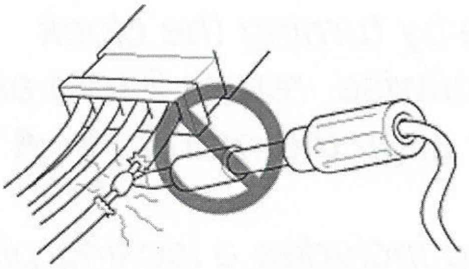
CASE STUDY #5 - HYUNDAI continued...

Detailed Inspection:

Wiring Precautions

SRS wiring can be identified by special yellow outer covering Observe the instructions described in this section.

- Never attempt to modify, splice, or repair SRS wiring. If there is an open or damage in SRS wiring, replace the harness.



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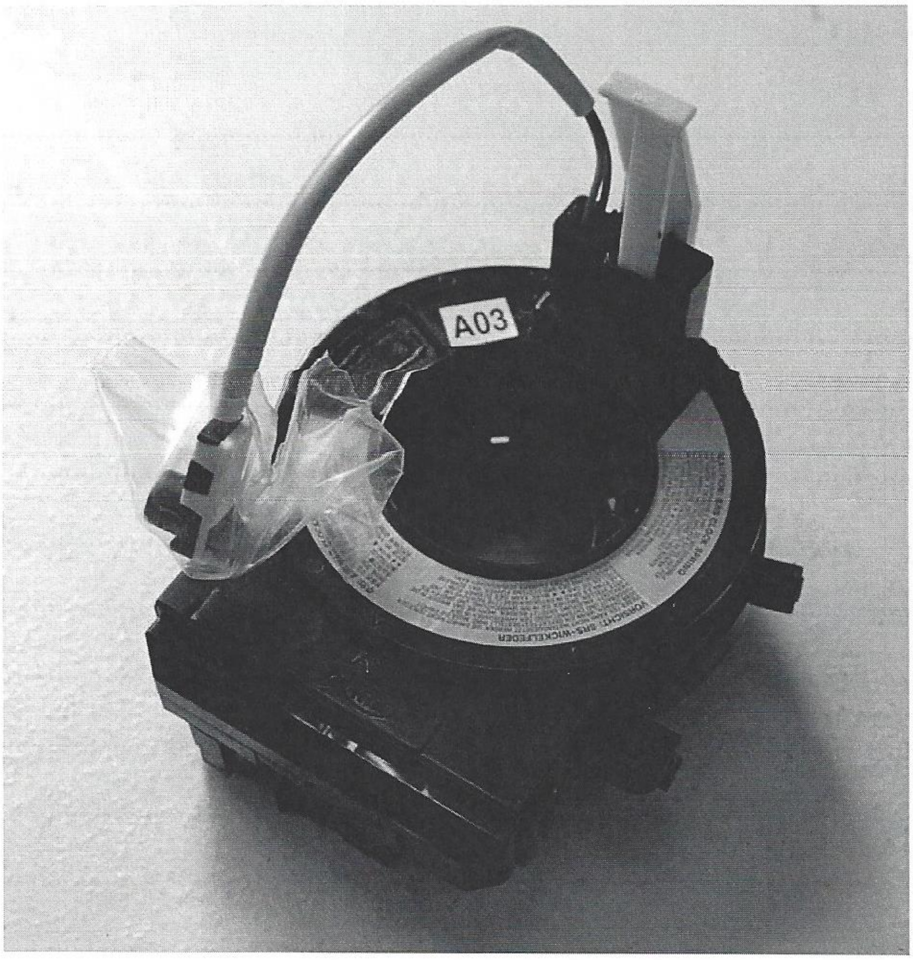
CASE STUDY #5 - HYUNDAI continued...

Perform Repair:

Caution: *Clock spring replacement precautions.*

- *Disconnect the battery for 3 minutes before working on the SRS*
- *Find the centre by turning the clock spring fully clockwise, return 2 turn anti-clockwise then align the marks "►◄"*

Note: *A new clock spring includes a locking pin that holds it centred, this must be removed once installed.*

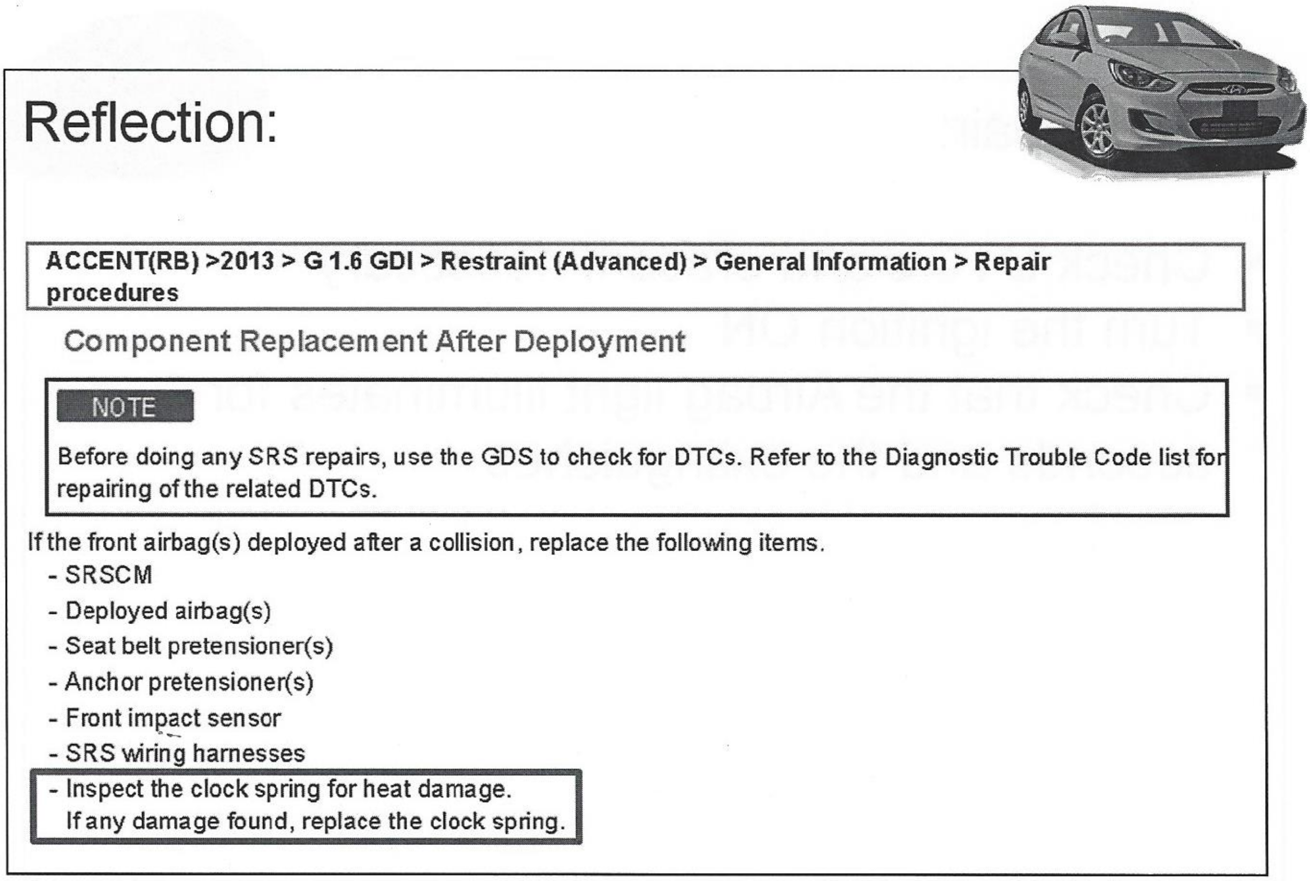


CASE STUDY #5 - HYUNDAI continued...

Verify Repair:

- Check DTC's and erase if necessary
- Turn the ignition ON
- Check that the Airbag light illuminates for 6 seconds and the extinguishes

CASE STUDY #5 - HYUNDAI continued...



Reflection:

ACCENT(RB) >2013 > G 1.6 GDI > Restraint (Advanced) > General Information > Repair procedures

Component Replacement After Deployment

NOTE

Before doing any SRS repairs, use the GDS to check for DTCs. Refer to the Diagnostic Trouble Code list for repairing of the related DTCs.

If the front airbag(s) deployed after a collision, replace the following items.

- SRSCM
- Deployed airbag(s)
- Seat belt pretensioner(s)
- Anchor pretensioner(s)
- Front impact sensor
- SRS wiring harnesses
- Inspect the clock spring for heat damage.
  If any damage found, replace the clock spring.

Historical SRS Topics

CHAPTER TOPICS

- ☐ Analogue G-Sensor
- ☐ Impact Sensors
- ☐ Mechanically Triggered Airbags
- ☐ Mechanical Seat Belt Pre-Tensioners

HISTORICAL SRS TOPICS

The following chapter includes information specific to older type Safety Restraint Systems. It is included here because although it is no longer cutting edge information, vehicles using these systems are still on the roads and in workshops around Australia.

Caution: *Some of the content in this chapter is not concurrent with present SRS design, operation or legislation. This information should be used as a guide only.*

Analogue G-Sensor

In an Analogue G-Sensor, a piezo-electric element senses the deceleration forces generated during a frontal collision. This force distorts the element causing it to generate an analogue voltage proportional to the force. The SRS ECM has a judgment circuit which monitors the signal and calculates the deceleration rate. The sensor has a self-check function that confirms sensor operation.

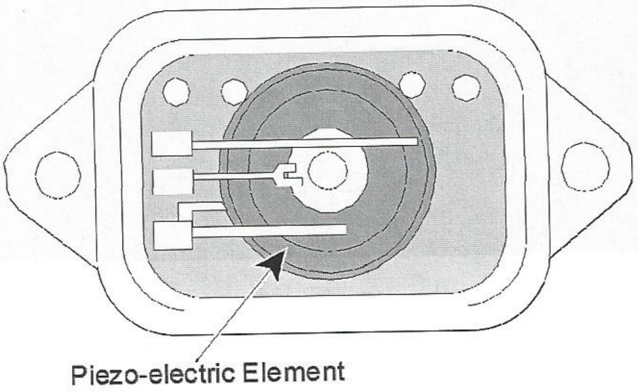


Diagram 22: Analogue G-Sensor

Impact Sensors

Contact Types

Different types of Impact Sensors are used by the different manufacturers. The main principle of operation of an Impact Sensor consists of: A moving contact (gold plated) which is held in place either by a magnet or spring. The impact on the vehicle will move the moving contact off its seat and make contact with the electrical connections at the other end of the sensor.
To maintain a high measure of sensor reliability, gold plating is used on the contacts within the sensor and the metallic case charged with an inactive gas.

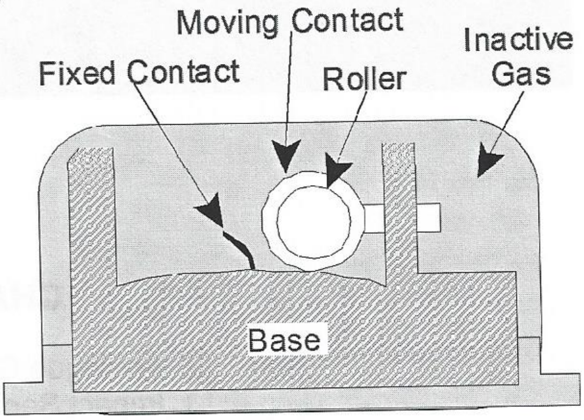


Diagram 23: Impact Sensor (type 1) - at rest

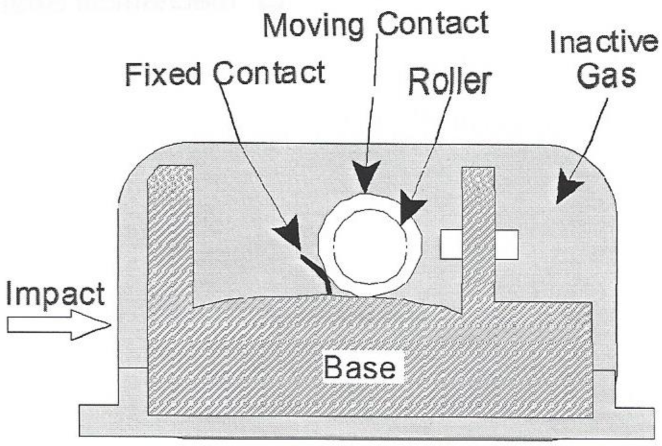


Diagram 24: Impact Sensor (type 1) - during impact

HISTORICAL SRS TOPICS continued...

Once contact has been made, this will allow current to flow to the Airbag ECM or to the Airbag itself. Some Impact Sensors will reset after the impact if the sensor is not damaged, while other types will have to be replaced once the Airbag has deployed.

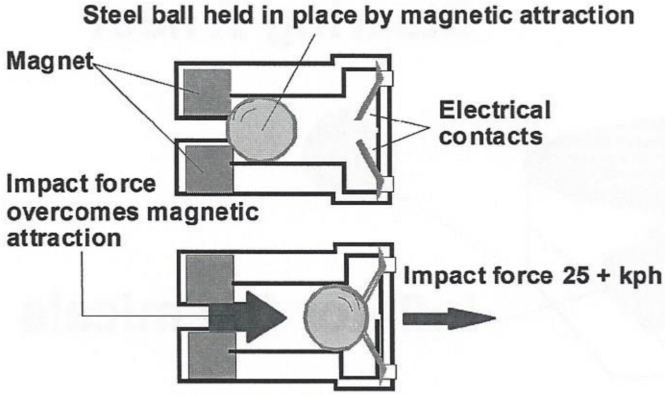

Steel ball held in place by magnetic attraction
Magnet
Electrical contacts
Impact force overcomes magnetic attraction
Impact force 25 + kph

Diagram 25: Impact Sensor (type 2)

If the Impact Sensor is damaged in any way it should be replaced with a new sensor. The Impact Sensor will be marked with an arrow showing the forward direction of the sensor. If the sensor is installed incorrectly the SRS may not deploy the Airbag.
When the sensor receives a force through a sudden deceleration impact, (higher than a predetermined value) the magnet compresses the spring forward by inertial force. The magnet closes the contacts of the reed switch, thereby allowing current to flow. The Safing Sensor is mounted within the SRS ECM.

Safing Sensor

Safing Sensors are used as a safety device to insure that the Airbag does not accidentally deploy. The Safing Sensor is usually a reed switch type. It consists of a spring, magnet and reed switch.

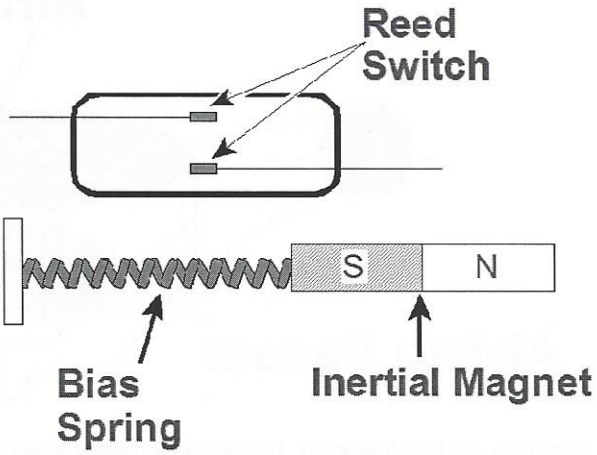

Reed Switch
S
N
Bias Spring
Inertial Magnet

Diagram 26: Safing Sensor – at rest

When the sensor receives a force through a sudden deceleration impact, (higher than a predetermined value) the magnet compresses the spring forward by inertial force. The magnet closes the contacts of the reed switch, thereby allowing current to flow. The Safing Sensor is mounted within the SRS ECM.

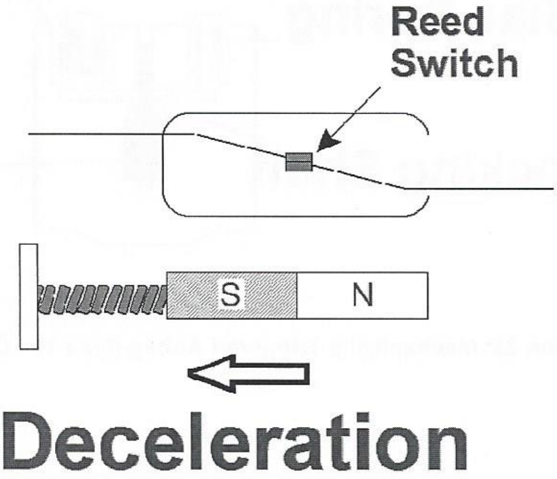

Reed Switch
S
N
Deceleration

Diagram 27: Safing Sensor – during impact

HISTORICAL SRS TOPICS continued...

Mechanically Triggered Airbags

Mechanically triggered Airbags are completely self contained within the steering wheel hub, there are no external sensors. Deployment of the Airbag occurs if the vehicle experiences impact de-acceleration of approximately the force of 20 to 40 kph (20 kph for hitting a brick wall, 40 kph for hitting a stationary vehicle).

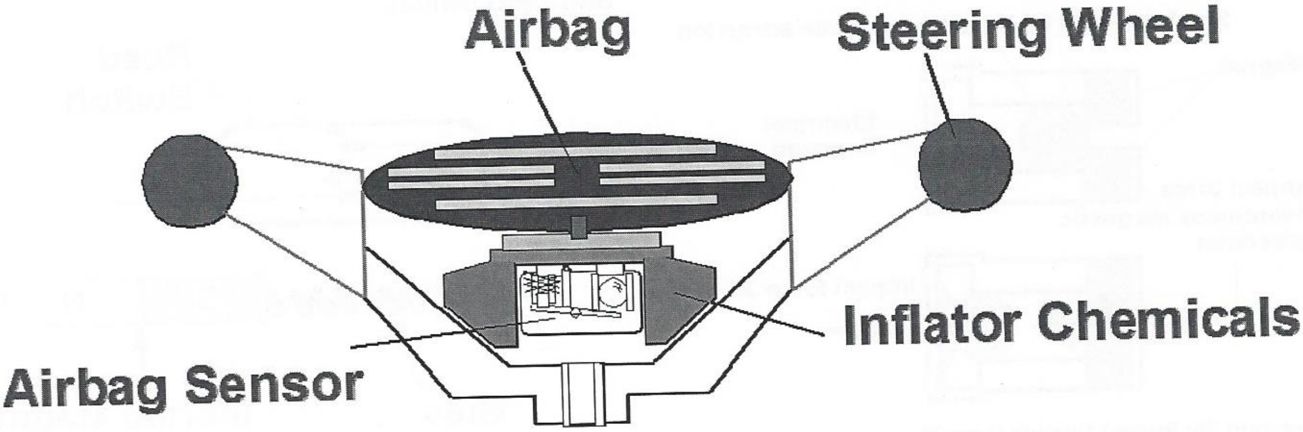

Airbag
Steering Wheel
Inflator Chemicals
Airbag Sensor

Diagram 28: Mechanically Triggered Airbag – Steering Wheel / Airbag (cross-section)

Type One

The Trigger Sensor contains 2 Large Floating Ball Bearings (one is a backup) which, when activated, forces a Firing Pin into the Igniter Squib, which activates the chemicals to generate the gas.

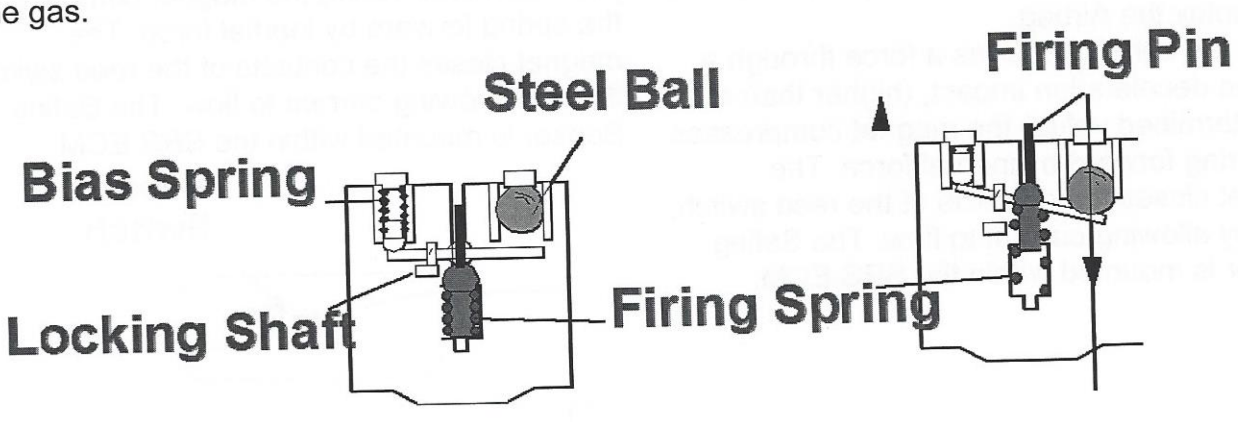

Steel Ball
Firing Pin
Bias Spring
Locking Shaft
Firing Spring

Diagram 29: Mechanically Triggered Airbag (type 1) – Operating Principle

HISTORICAL SRS TOPICS continued...

Type Two

The sensor unit is stored in the inflator and it consists of a weight, cam, lock lever, lock spring, lock shaft, torsion spring and firing pin. In addition, a safety device is installed to prevent the air bag system from being deployed by the steering wheel pad assembly. The firing pin is normally latched to the weight via the cam, thus preventing the firing pin from ejecting. If a collision occurs, the vehicle will decelerate immediately and the weight will rotate around its fulcrum. If the vehicle continues to decelerate at a rapid rate, the weight and cam rotate until the firing pin disengages from the cam adjoining portion. The firing pin is ejected by the torsion spring force to fire the primer.

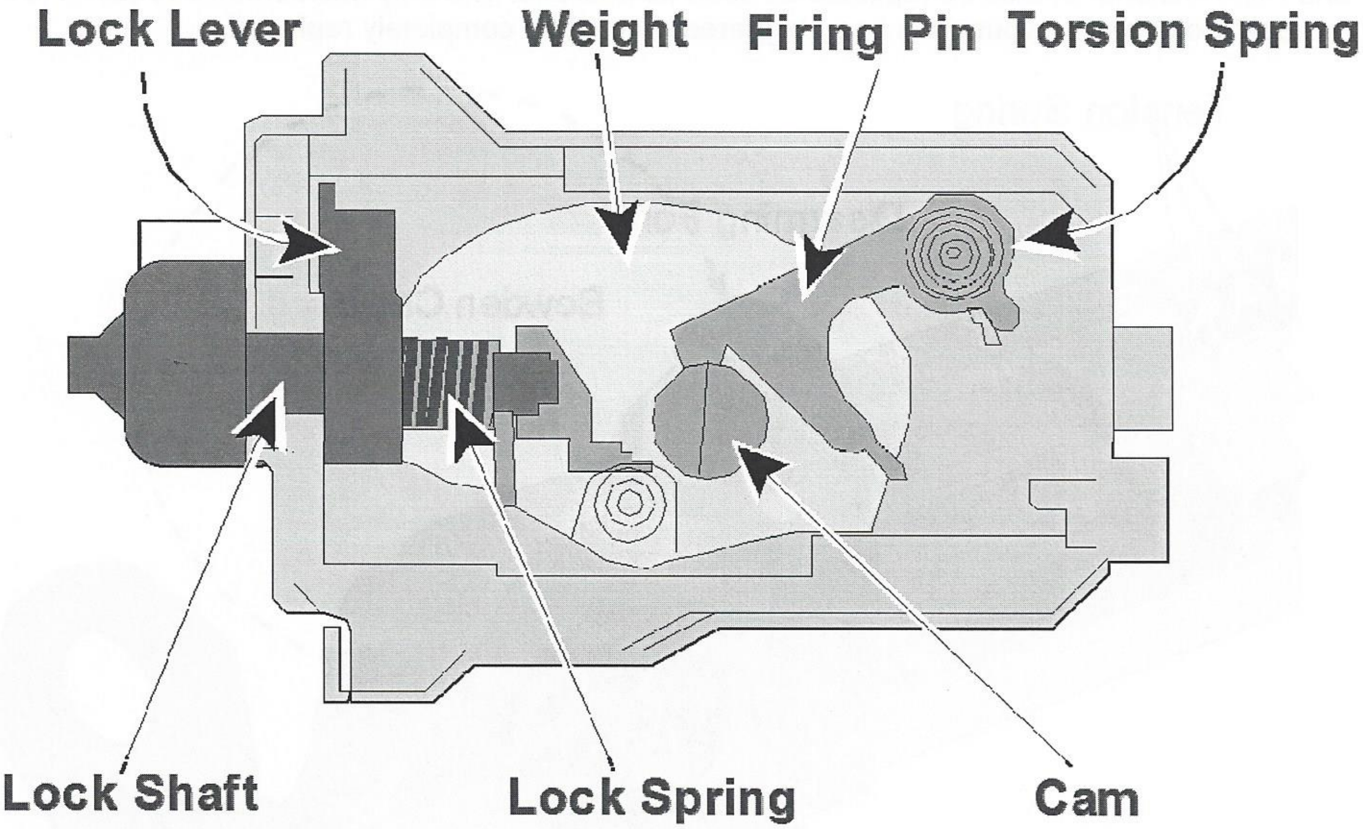


Diagram 30: Mechanically Triggered Airbag (type 2)

Disarming Airbag

When the sensor lock release bolt is loosened, the rotation lever rotates. This causes the lock lever inside the sensor to be rotated by the lock spring so that the lock lever integrated with the lock shaft prevents the weight from rotating. Therefore, the weight cannot rotate even if a strong decelerating force acts on the weight, so the Airbag is disarmed.

HISTORICAL SRS TOPICS continued...

Mechanical Seat Belt Pre-Tensioners

Mechanical Seat Belt Pre-Tensioner (European Holden's)

Mechanical Seat Belt Pre-Tensioners are fitted as standard items on some vehicles. The Seat Belt Pre-Tensioners will deploy via a Mechanical Device. When the Seat Belt Pre-Tensioners are triggered, A Pre-Tensioned Spring draws back the belt via a Bowden Cable and Return Block. The cable will pull the belt back by up to 80mm. When working on vehicles with Mechanical Pre-Tensioners, a locking clip must be used to stop the Pre-Tensioner from deploying (See Disarming the seat belt). A triggered Seat Belt Pre-Tensioner can be recognised from the yellow tongue on the belt buckle. The yellow tongue will be exposed. The Seat Belt and Pre-Tensioner should be replaced as soon as possible. The only maintenance required is if the Seat Belt Pre-Tensioner has been triggered. It must be completely replaced.

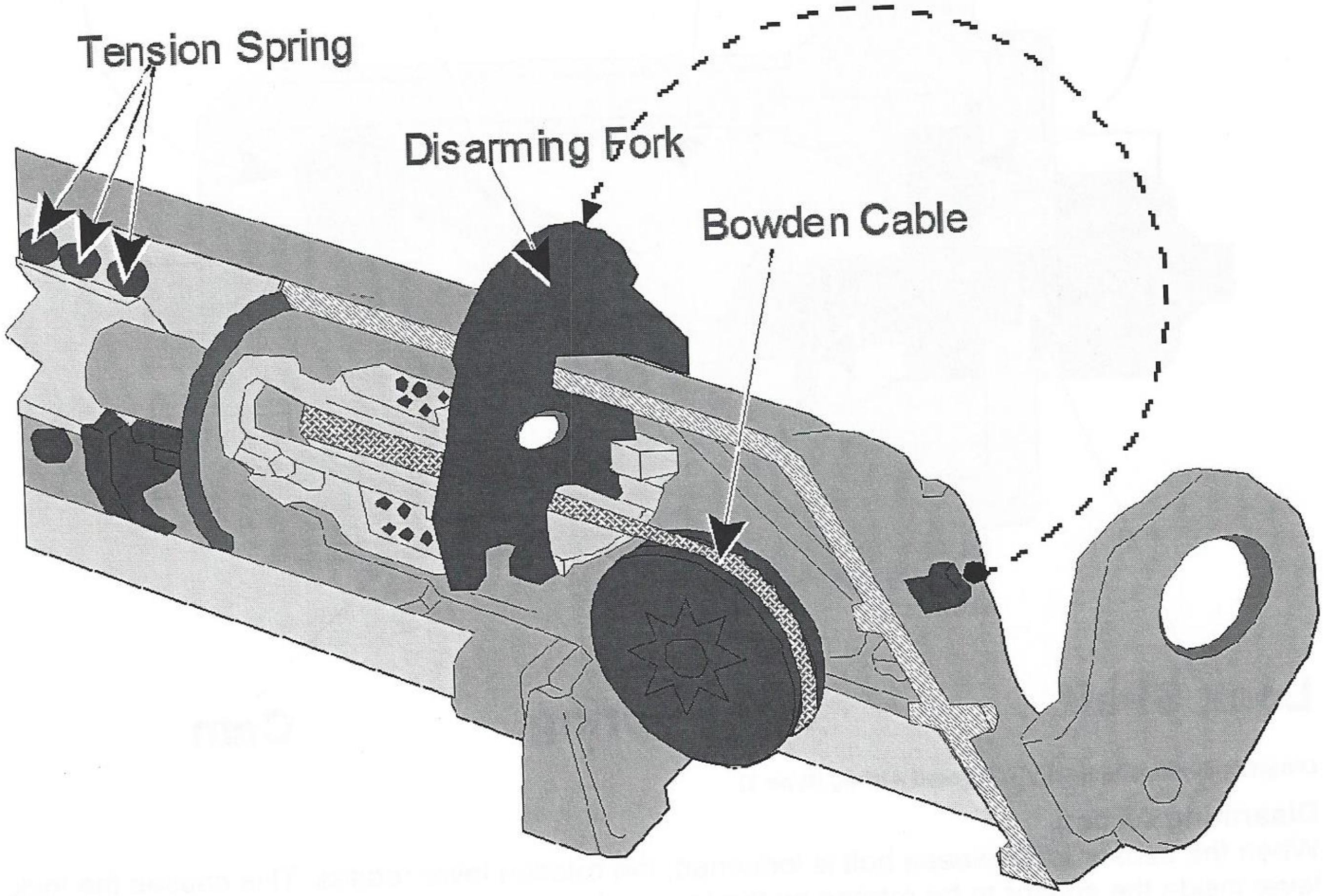


Diagram 31: Mechanical Pre-tensioner (Holden) - Disarmed

Disabling the Seat Belt Pre-Tensioner (European Holden's)

To prevent accidental deployment when installing, transporting, removing or working on the vehicle front seats, the securing fork attached to the Mechanical Seat Belt Pre-Tensioner should be inserted into the Pre-Tensioner Unit. To do this, the securing fork is inserted at a right angle ON the guide tube.

HISTORICAL SRS TOPICS continued...

Mechanical Seat Belt Pre-Tensioner (Toyota)

Disabling the Seat Belt Pre-Tensioner
Mechanical Seat Belt Pre-Tensioner Active Safety Device. To activate the safety lock, the sensor lock button on the left side of the Seat Belt Pre-Tensioner Assembly must be pushed in, and the yellow lever turned clockwise.

Enabling the Seat Belt Pre-Tensioner
Turn the yellow lever counter clockwise and press it in.

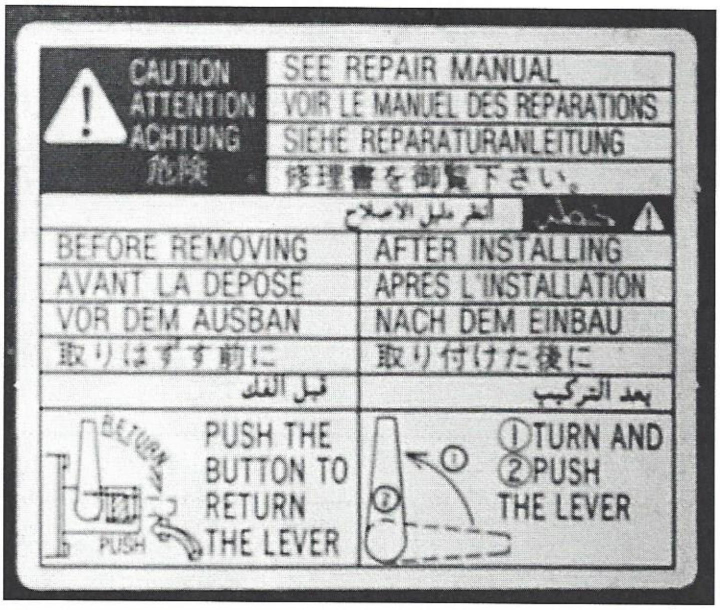

CAUTION
ATTENTION
ACHTUNG
危険
SEE REPAIR MANUAL
VOIR LE MANUEL DES REPARATIONS
SIEHE REPARATURANLEITUNG
修理書を御覧下さい。
أنظر دليل الاصلاح
خطر
BEFORE REMOVING
AVANT LA DEPOSE
VOR DEM AUSBAN
取りはずす前に
قبل الفك
AFTER INSTALLING
APRES L'INSTALLATION
NACH DEM EINBAU
取り付けた後に
بعد التركيب
RETURN
PUSH
PUSH THE BUTTON TO RETURN THE LEVER
①TURN AND ②PUSH THE LEVER
①
②

Diagram 32: Mechanical Pre-tensioner (Toyota) – Operating decal

Note: *The centre pillar garnish has a structure to prevent a clip from inserting in its hole without releasing the safety lock first!*

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